A TAXONOMY AND EXPERIMENTAL DESIGN TO STUDY THE IMPACT OF MODE OF INFORMATION PRESENTATION ON DECISION EFFECTIVENESS

By

GEETHA R. MANICKAM

Submitted to the Graduate Faculty of the
Department of Management,
College of Business Administration,
Oklahoma State University,
in partial fulfillment of
the requirements for the Degree of
MASTER OF BUSINESS ADMINISTRATION

May, 1989

ABSTRACT

Decision effectiveness depends on the mode of information presentation, that provides information to support decision making, which in turn is a function of the characteristics of the task at hand. Task characteristics depend primarily on the type of the task and the level at which the decision is being made in the organization. Thus, for studies attempting to evaluate the impact of mode of information presentation on decision effectiveness, it is important to appreciate the interdependence between the type of task (structured/semistructured/unstructured), level of managerial activity (top/middle/lower), and the mode of information presentation (tables/graphs/tables & graphs etc.).

We propose a two-dimensional (three-by-three) taxonomy, based on Gorry and Scott Morton's [GoS71] framework, within which the existing studies have been categorized. It is evident, that most researchers have focused on structured decisions and/or decisions at the operational level.

A set of experiments are proposed to evaluate the impact of the mode of information presentation across the structured-unstructured continuum for the three levels of managerial activity. We consider only two modes of information presentation - graphs and tables. For each level of managerial activity, irrespective of the structure a specific task activity is identified. The structure is then varied by changing the number of variables to be processed. The task

environment involves the evaluation of the emergency medical services provided by a hypothetical ambulance firm AMBUCARE.

The experiments will be administered to 18 groups of randomly selected subjects from a homogenous population, who will be randomly assigned to the 9 cells and the two modes of presentation. The decision effectiveness will be measured by comparing the subjects' decisions to a "near-optimal" solution obtained using analytical methods. The impact of mode of information presentation on decision effectiveness will then be analyzed using statistical methods.

A TAXONOMY AND EXPERIMENTAL DESIGN TO STUDY THE IMPACT OF MODE OF INFORMATION PRESENTATION ON DECISION EFFECTIVENESS

Report Approved:

Advisor(s)

Director of Graduate Studies

Head, Department of Management

Name: Geetha R. Manickam Date of Degree: May 1989

Institution: Oklahoma State University

Location: Stillwater, Oklahoma.

Title of Study: A TAXONOMY AND EXPERIMENTAL DESIGN TO STUDY THE IMPACT OF MODE OF INFORMATION PRESENTATION ON DECISION EFFECTIVENESS

Pages in Study: 87 Candidate for the Degree of Master of Business Administration

Major Area: Management Information Systems

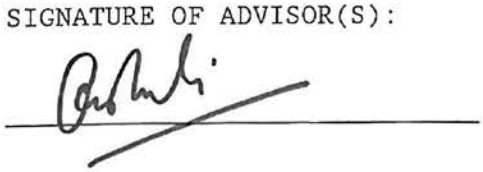
Scope of Study:

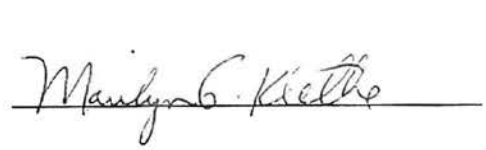
The primary purpose of this study is to develop a taxonomy and propose an experimental setup to gauge the impact of the mode of information presentation on decision effectiveness. A two dimensional (three-by-three) taxonomy of previous studies is developed based on the Gorry and Scott Morton's [GoS71] framework. This research overcomes the drawbacks of previous studies through the choice of suitable dependent variables, control of measuring instruments, study of information presentation mode only as "decision aids", control of quality and content of presentation and finally, a taxonomy development. Three experiments were designed using a hypothetical ambulance firm task environment, for the structured column of the framework. The experimental design for the remaining cells is also proposed.

Conclusions:

The review of previous studies revealed that most studies have focused on structured decisions and/or decisions at the operational level. In our review a majority of the studies occupied only one cell, with the exception of a few that were assigned to more than one cell. It is intended that this taxonomy will provide a basis for comparison of tasks that fall within the same cell and thus, alleviate some of the contradictory findings in the mode of presentation area. This research proposes an integrated set of experiments for the nine cells and the results will be compared to studies that fall in that particular cell.

SIGNATURE OF ADVISOR(S):





ACKNOWLEDGEMENT

I would like to express my gratitude to Dr. Marilyn G. Kletke, Associate Professor, Department of Management, my advisor, for giving me the opportunity to work on this research. I am grateful for her assistance and guidance throughout the project. Her constant encouragement and motivation have helped me get this far in this research. I also thank her for providing the data-set for the experimental design.

My sincere thanks to Prof. A. Chahande who conceived the idea of this project. His help in the survey and review of existing literature and the experimental design is appreciated.

Lastly, I would like to extend my thanks to the Office of Business and Economics Research (OBER) for affording me an access to their facilities.

TABLE OF CONTENTS

EXHIBITS

1.0 INTRODUCTION

1.1 Introduction

Mason and Mitroff [MaM73] stated

".... that an information system consists of at least one PERSON of a certain PSYCHOLOGICAL TYPE who faces a PROBLEM within some ORGANIZATIONAL CONTEXT for which he needs EVIDENCE to arrive at a solution (i.e., to select some course of action) and that the evidence is made available to him through some MODE OF PRESENTATION." [pg.475].

The authors have in the above definition brought out the key variables that form the conceptual basis for MIS research.

There has been a surge of studies concerning the effect of the PSYCHOLOGICAL TYPE on decision effectiveness/performance ([MaM73], [DSC77], [Zmu79], [LuK79], [Dav81], [LuN80], [BDT86]). It has been argued that what is information for one type may not be information for another [MaM73]. Therefore, one should cater to each psychological type separately and present information in the way that is best suited for that type [MaM73]. However, recently this concept of placing excessive emphasis on the type of the decision-maker as a variable in MIS research has been subject to criticism. Chervany and Dickson [ChD78] have stated that

"Many researchers involved in the analysis of individual characteristics (e.g. cognitive style) as predictors of human behavior have reached a troublesome conclusion. Specifically, they have concluded that the study of individual differences as predictors of human behavior/performance have been basically unsuccessful. Researchers have not been able to predict consistently behavior/performance on the basis of individual personality characteristics. Rather, behavior appears to be (to a very large degree) determined by the characteristics of the task in which the individual is involved".

It has also been proved that the currently available literature on cognitive styles is weak and inconclusive and hence not recommended for deriving operational guidelines for MIS [Hub83]. Benbasat et al. [BDT86] did not find any significant relationship between information presentation format and cognitive style in explaining variation in performance. Jarvenpaa and Dickson [JaD88] argue that although cognitive style is one of the individual difference variables that has been more frequently studied, it does not seem to have a strong relationship to the presentation format.

Hence, in this research, the type and style of the decision maker are ignored, giving more emphasis to task considerations, which dominate style considerations.

The next variable that Mason and Mitroff [MaM73] have discussed is PROBLEM, which was classified by them as structured and

unstructured decision problems. It has been widely accepted that understanding the characteristics of the task in hand in which the subject is involved will determine the effectiveness of the information presentation ([JDD85], [DDM86]). Jarvenpaa et al. [JDD85] have suggested that a taxonomy of tasks be developed, which considers characteristics of tasks, so that future research may eliminate contradictory results produced this far. Thus, the type of task is one of the key variables in this research and is considered at three levels: structured, semi-structured and unstructured.

Mason and Mitroff [MaM73] have followed Herbert Simon's [GoS71] division of ORGANIZATIONAL CONTEXT into strategic planning, management control and operational control. Mason and Mitroff, [MaM77] Benbasat and Schroeder [BeS77] have pointed out that most of the research has concentrated on operational level decisions and hence in future attention should also be given to the middle and strategic level of the organization structure. This research thus, gives all the three levels of managerial activity a high priority and approaches the mode of presentation problem from this perspective as well.

The fourth variable EVIDENCE has been defined as information upon which the manager's decisions will be based [MaM73]. Information can be presented through different MODES OF

PRESENTATION, which is the fifth variable in Mason and Mitroff's definition. The term MODE OF PRESENTATION is referred by them as the form of output from an information system. Form of presentation includes narratives [Pet82], tables, graphs etc. However, in recent years, the two dominant forms of presentation that researhers have concentrated on have been tables and graphs ([BDT86], [BeD85], [BeD86], [DeJ85], [DDM86], [DSC77], [Gha81], [JaD85], [Jar86], [Luc81], [LuN80], [PLS84], [Rem84], [StW84], [Tul81], [UmS88], [WaD83], [Yan87], [ZMB83]). The display format used for these two forms varies between hard copy/printed output to the use of cathode ray tube terminals and teletype terminals. The information content in the tables can include raw data/summarized data/percentiles and the graphs can be a scatter plot/line graph/pie chart/horizontal bar chart/vertical bar chart/map. Research has also been done on how color enhances information displays ([Tul81], [BeD85], [BeD86], [BDT86]). Tullis [Tul81] found that there was no significant difference between response times for the black-and-white graphic and color graphic formats. Color did seem to improve decision making when high time constraints were present [BeD86] and was found to suit certain decision maker types [BDT86]. However, Jarvenpaa and Dickson [JaD88] have not considered color in their guidelines for the usage of proper graphic formats. They have stated " Color is not considered because 1) it is not a graphical feature; color can be added both to tabular and graphic presentation, and 2) few studies have yet been performed in the application of color in

an organizational context." Even Ives [Ive84] felt that color rarely enhances comprehension of information or improve task performance.

Hence, since the benefits of color are not all pervasive and seem to aid decision making in specific circumstances, it is not considered in this research. Here the two modes of presentation include graphs and tables with a hard copy display format.

The impact of mode of presentation can be measured through different ways. Here the impact is measured through decision effectiveness. Effectiveness in this case is distinguished from efficiency. According to Parker [Par89] ".... being effective means having done the right thing, whereas being efficient means that something was done the right way. .... Organizations tend to measure and control efficiency much more than they do effectiveness, although the reverse should be true. Efficiency measures are often easier to produce than effectiveness measures."

Effectiveness pertains solely to the decision itself, as opposed to the decision making process, and can be measured by choosing a 'bottom line' variable for validation purposes. Efficiency, however, is concerned with the decision-making process and could include variables like time and cost spent on making the decisions. One could make an 'efficient' decision, for example, that might not be at all effective. The objective for differentiating between the two is to reduce the large numbers of independent and dependent

variables, that have produced conflicting results in the past [PLS84], and to concentrate on a narrow spectrum of variables.

1.2 Organization of this Research

The organization of this paper is as follows. Section 2.0 briefly reviews the past research studies and the existing table vs graphs controversy. Current research considerations are discussed in Section 3.0. Section 4.0 proposes a two dimensional (three-by-three) taxonomy to compare and integrate the existing studies. The experimental design, the task environment and the experiments are covered in Section 5.0. Finally, Section 6.0 outlines the conclusion and future research steps.

2.0 BACKGROUND

2.1 Literature Review

Since Mason and Mitroff [MaM73] pointed out mode of presentation to be an important design variable, it has received the attention of researchers. These studies have typically centered around the graphs vs tables presentation of data.

The Minnesota experiments [DSC77] examined the significance of various information system characteristics on decision effectiveness and the results showed that information system structure and/or individual differences(attributes) affect decision effectiveness.

Benbasat and Schroeder [BeS77] examined the effects of a set of six information system and decision maker variables on cost performance, time performance and report usage. The mode of presentation was graphs and tables and the subjects interacted through CRTs' to make production and inventory level decisions. The results indicated that graphical presentation lead to lower costs and lower number of reports requested. In 1985, Benbasat and Dexter [BeD85] studied the influence of graphical and color enhanced information presentation in the 'Brand Manager's Allocation Problem'. The independent variables included report format (tables and graphs), color (mono vs multi) and individual differences (field-dependent vs field-independent). There was no performance difference between table and graph users and the benefits of color

were not significant. However, the importance of how reports should support tasks was brought out in this research. Benbasat and Dexter [BeD86] used the same 'Brand Manager's Allocation Problem' to study the effects of color and information presentation once again, under varying time constraints. In this case information was presented in graphs, tables and combined tables and graphs. The combined report was found to be superior in terms of performance. Color lead to improved decision making in high time constraints. Benbasat et al. [BDT86] further explored the color-enhanced presentation, by conducting three lab experiments using the same allocation problem. Here multicolor reports and graphs were found to aid decision making only in specific circumstances. The above four studies have dealt with a number of dependent variables and no definite conclusion could be drawn from the results.

There are studies that have examined lesser number of dependent variables and still produced varying results. These studies also failed to provide adequate support for graphics. Lusk and Kersnick [LuK79] conducted a field experiment whereby the subjects had to answer 20 questions based on information presented to them in either tabular or graphic form. The results showed that tables were perceived to be less complex and improved task performance. Lucas and Nielsen [LuN80] used a logistics management game to examine the effect of variations in the mode of information presentation on performance and learning. The reports were presented on CRT or teletype printer, with some groups getting graphical and other,

tabular reports. The hypothesis that graphics presentation will result in greater learning and performance received very little support. Watson and Driver [WaD83] examined the effect of three dimensional graphics and tabular mode of presentation on the recall of information, and found that graphs were not superior to tables in immediate and delayed recall. Remus [Rem84] used graphical and tabular displays as decision aids in a production scheduling problem. Tables yielded lower cost than graphics when erratic components of decisions were reduced. Powers et al. [PLS84] tested the hypothesis that a combination of tables and graphs will improve comprehension and accuracy, than by using either form alone. In this case tables were superior to both graphs and the combination of tables and graphs. Remus [Rem87] found tables to suit low complexity tasks and graphs intermediate complexity tasks. Jarvenpaa and DeSanctis [JaD85] conducted an experiment where the subjects played the role of consultants to help the CEO find reason for falling profits at a time of increasing sales. There was no significant difference between tables and graphs with respect to decision quality, time and decision confidence. Peterson [Pet82] found that reader retention was best when tables with narratives were used to answer questions on a report called 'Trends in Employment'. Lauer [Lau86] found tables to be superior when questions were to be answered based on time-series information of a financial nature.

Some studies have however, found graphs to be superior to tables. When Tullis [Tul81] required subjects to make decisions about the nature of the problem on a telephone line testing system, he found subjects with graphs made faster decisions. Dickson et al. [DDM86] found that in a market demand forecasting problem subjects with graphs outperformed those with tables. DeSanctis and Jarvenpaa [DeJ85] used subjects to develop financial forecasts for fictitious companies over five experimental trials and the results showed better quality of decisions with graphs.

The mode of presentation has also be studied from the cognitive process angle. Davis [Dav81] found that the best format varied across the user type - Sensitive thinking, Intuitive thinking, Sensitive feeling, Intuitive feeling. Ghani [Gha81] found that feeling types prefer graphics and thinking types prefer tables. Benbasat et al. [BDT86] in their study found that field-dependents prefered tables and field-independents preferred graphs.

In 1986, two studies ([BDT86], [DDM86]) were conducted that varied the structure across three experiments. Different results were obtained with respect to mode of presentation for each experiment. In [DDM86], in the first experiment of a financial/accounting context there was no difference between tables and graphs. In the second experiment, which was a market demand forecasting problem, subjects with graphs outperformed those with tables. In the last experiment of a general managerial context,

graphs outperformed tables only where vast amount of information was presented.

2.2 Graphs vs Tables

From the above literature review it is evident that mode of information presentation has been a controversial issue. DeSanctis [Des84] stated that there has been only a limited amount of research in computer graphics and most of it has focused on the tables vs graphs controversy. While several researchers have proved through experimental evidence that graphics lead to better decision performance in certain situations ([BeS77], [Zmu78], [ZBM83]), there are other researches which show that graphs are no better than tables in presenting information ([Gha81], [Luc81], [LuN80], [Pet82], [PLS82], [WaD83], [Lau86]). Why is there a lack of meaningful pattern in the research dealing with tabular vs graphical presentation of data? There are several reasons for these conflicting results.

2.2.1 Rationality for choosing dependent variables

According to DeSanctis [Des84] there is "..... no formal discussion of the rationale for choosing particular dependent variables". Some researchers have studied more than one dependent variable. Adequate attention has not been paid by researchers, as to what they want to measure or what outcome variables they want to examine. The general assumption made in these studies is that a particular mode of presentation will increase the effectiveness of

decisions and/or the efficiency of the decision making process. Within this broad set up of effectiveness and efficiency, other variables may be relevant like accurate interpretation, problem comprehension etc. which may enhance effectiveness or efficiency. Then there are other dependent variables like decision quality which pertain exclusively to effectiveness and decision speed which is a measure of efficiency. Then one has memory (recognition and recall) and viewer preference, which are related to the cognitive process experienced by an individual as an information display is read [Des84]. So are the researchers measuring 'effectiveness', 'efficiency', 'cognitive processes' or a combination of two or a combination of all three?

Benbasat and Schroeder [BeS77] have used three dependent variables (cost performance, time performance and no. of reports required), Benbasat and Dexter [BeD85] have used three dependent variables (profit performance, time performance and report attribute ratings) and Benbasat et al. [BDT86] in their second experiment have used as many as five dependent variables (report usage, time, no. of trials, profit performance, report ratings). The above studies prove that the researchers have tried to measure all three - effectiveness, efficiency and cognitive process. There are other studies with dependent variables pertaining to effectiveness alone, like cost ([Rem84], [Rem87]), task performance [LuK79], readability, interpretation, decision quality [DDM86], and performance [UmS88]. Further, studies pertain only to efficiency alone, like speed and

accuracy [Tul81] or to cognitive process alone, like immediate and delayed recall [WaD83]. Hence it can be seen that different researchers have tried to measure different outcomes and any comparison between them is bound to produce conflicting results.

2.2.2 Diversity of experimental tasks

Benbasat et al. [BDT86] stated "A major cause of the contradictory results might be the various and differing nature of tasks used in these experiments and the match(or mismatch) between the task and presentation method".

Different researchers have used different task settings from budget allocation problems across three marketing territories ([BeD85], [BeD86], [BDT86]) to production scheduling problems ([Rem84], [Rem87]) to market demand forecasting problem [DDM86]. The first ([BeD85], [BeD86], [BDT86]) are middle level management decisions, whereas the latter two ([Rem84], [DDM86]) are operational level decisions. Furthermore, not only is the level of managerial activity an important criteria in comparing tasks but also the extent to which the decision-making task is structured/semi-structured/unstructured [MaM73]. While Remus [Rem84] has dealt with a structured problem, DeSanctis et al. [DDM86] and Benbasat et al. [BDT86] have conducted three experiments each, varying the structure across each. Hence one has been comparing task activities not only across different levels of managerial activities but also across different degrees of structure. Therefore, even though the mode of presentation in all these researches was tables and graphs, not all

of them have common task characteristics and any such comparison will produce conflicting results. According to Jarvenpaa [Jar86] "Comparing results in one task activity with those in another is inappropriate unless the researcher also considers the characteristics of each task".

2.2.3 Proliferation of measuring instruments for the same construct variable

Another problem pointed out by Jarvenpaa [Jar86] is the use of a great number of measuring instruments. For example, 'task performance' was measured by Lucas and Neilsen [LuN80] by cumulative profit, whereas Benbasat and Dexter [BeD86] have considered both profit and time taken and Remus [Rem84] has used linear and quadratic cost functions. DeSanctis [Des84] has stated that 'memory' has been studied using recall tasks when data is presented in a table or narrative form but recognition is used when information is presented in picture or graph form. Although the researchers may be justified in using the measuring instrument best suited for their experiment, it makes comparing of results difficult and leads to conflicting conclusions.

2.2.4 Handling of the individual difference variable

There has been no common ground for developing hypotheses and interpreting results with respect to individual differences. Some researchers ([BeS77], [Luc81], [BeD85]) have considered cognitive style by categorizing the subjects into heuristic vs analytical [Luc81] or field-dependent vs field-independent [BeD85] or high vs

low analytics [BeS77]. It is to be remembered that cognitive style is one among many individual difference variables. Lucas and Nielsen [LuN80] have considered groups with differing experience and professional backgrounds. Zmud [Zmu79] has pointed out other differences like personality (internal locus of control, low degree of dogmatism, risk-taking, propensity, confidence, extrovert/introvert) and demographic and situational (general intelligence, quantitative ability, verbal ability) variables. Davis [Dav81] has dealt with the psychological type of the user (IT-intuitive-thinking type, ST-sensation-thinking type, IF-intuitive-feeling type, SF-sensation-feeling type) based on Jungian psychology of types. Hence it is seen that some researchers have dealt with only one aspect of individual difference, others have dealt with many more. Furthermore, DeSanctis [Des84] has stated "Human information processing as reflected in user's decision strategy and memory for information is different for graphics than for other display methods". There is also the problem of whether all researchers are equipped enough in the psychological aspects of human behavior, to deal with cognitive ability or other variables on the same plane and with the interactions of the positive and negative characteristics of the user.

2.2.5 Quality and content differences

Ives [Ive82] has stated that ".. the relative quality of the competing presentations must be held constant if a fair comparison is to be made; ..." The quality of the two modes of presentation in

various studies have raised doubts. There are studies that have compared multicolor graphs to mono color tabular reports ([BeD85], [BeD86], [BDT86]). Thus one cannot attribute the differences, if any, to graphs alone. Researchers have also found difficulty in retaining the same content in graphs and tables. The problem is aggravated by the fact that graphic presentations also have varying amounts of narrative or even tabular supporting information. In the words of Ives, it is an "apples to oranges" comparison.

2.2.6 Form of presentation and medium of presentation

Some researchers have used CRTs' or teletype printers or hard copy terminals as the medium of display, where as others have just used hard copy printouts. Lucas and Nielsen [LuN80] had graphical presentations on a graphics terminal which had a slow speed and tabular presentations were made on a teletype printer. Lucas [Luc81] compared hard copy terminals and CRT and also used the CRT to display graphical and tabular data. The results in [Luc81] indicated that tabular groups on the hard copy printing terminal had the best performance scores in the experiment. Lucas [Luc81] attributed this to the fact that decision makers may not have experience with graphics and CRT terminals. In such cases it is difficult to ascertain whether effects of treatment are due to the form of presentation (graphs and tables), medium of presentation (CRT, teletype printer etc.) or an interaction between the two.

2.2.7 Other methodical problems

A number of methodical problems have been pointed out by

Jarvenpaa [Jar86] with respect to graphical research - lack of theory-based research, deficient and limited research support and inadequate experiment control.

3.0 CURRENT RESEARCH CONSIDERATIONS

3.1 Choice of dependent variables

DeSanctis [Des84] has given the major dependent variables used in graphics research and the rationale for using them. DeSanctis [Des84] also points out that these dependent variables are all relevant to the graphic researcher. In this research the guidelines of DeSanctis [Des84] is followed. As 'decision effectiveness' is the main variable to be measured, decision quality is the appropriate dependent variable as per DeSanctis's table [Des84]. According to DeSanctis [Des84], the rationale for using decision quality is "...because the user can better understand the problem, he/she is more likely to make a good decision when viewing a graph than when viewing a table". Since DeSanctis has used the words "better understand the problem" it is considered unnecessary to use the dependent variables interpretation accuracy and problem comprehension, since decision quality is considered pervasive enough to cover these two. The rationale for using the dependent variable task performance [Des84] "...is because comprehension of data is better, performance on a task involving use of that data will tend to improve". As this variable is linked to comprehension it is ignored. The other two dependent variables - speed of comprehension and decision speed, as per this research pertain to efficiency and hence are not considered. The dependent variable memory for

information has produced conflicting results in the past and is not considered important for decision effectiveness, as the subjects will have access to hard copies when making decisions. The last dependent variable, viewer preference is assumed to fall in the individual difference category and as this research is not looking at this aspect, it is ignored.

3.2 Development of Taxonomy

A three-by-three classification scheme is developed with level of managerial activity on one side and the degree of task structure on the other [GoS71]. This will provide a foundation for comparing previous studies which fall in the same level of managerial activity and task structure.

3.3 Control of measuring instruments

Since decision quality is the dependent variable, the independent variables are form of presentation, managerial activity, task structure and the necessary 'bottom-line' variables. Form of presentation is the treatment variable and managerial activity and task structure are the moderating variables.

3.4 Study of mode of presentation as 'decision aids' only

DeSanctis [Des84] has studied the use of graphics from two aspects - cognitive process and as decision aids. This research is concerned only with the use of graphs and tables as decision aids.

Huber [Hub83] argued that cognitive style is only one of the many individual differences that is related to human behavior and to correlate and design a system which encompasses all the differences is an overwhelming task. Further, it is felt that to design or present information in a manner that is most suited for the individual would amount to restricting the individual's ability to see things differently and not provide any challenge. It is assumed that a person occupying a certain managerial position has certain inherent ability to handle the job and through sufficient coaching and training if necessary, will be able to use the presentation format effectively. DeSanctis and Jarvenpaa [DeJ85] have in their three experiments found out that the effectiveness of graphics as decision aids depends on practice. Therefore, it is first essential in a general sense to find out what presentation mode is suitable for a particular task and then if essential, some of the individual's expressed preferences can be catered to. In the words of Zmud et al. [ZBM83] "Humans, being both flexible and intelligent, seem very willing to adapt to those information processing behaviors most appropriate for a given task situation, given contextual pressures, even if their information processing preferences might suggest otherwise".

3.5 Control of quality and content

To maintain quality control between the two formats, color is ignored. The same amount of information is provided in the tabular

and graphical presentation to avoid content differences. No CRTs' are used, so that any difference can be attributed to the form of presentation alone.

4.0 TAXONOMY OF EXISTING LITERATURE

4.1 Need for Taxonomy

Jarvenpaa [Jar86] has pointed out the importance of a task taxonomy. According to Jarvenpaa [Jar86], the implication of the task-dependence ".. is that in order to explain the behavior across many experiments, we have to account for differences in task characteristics (e.g., task goals, task pressures and constraints, degree of task structure, task complexity, task content, task difficulty)". Most of the previous researchers have ignored the role of task, with the exception of Dickson et al. [DDM86] and Benbasat et al. [BDT86]. In their experiments ([DDM86], [BDT86]), there proved to be a distinct relationship between task and mode of presentation.

4.2 Taxonomy based on Gorry and Scott Morton's framework

Task environment is a function of the structure of task (problem type - [MaM73]) and the level of organizational activity (organizational context - [MaM73]). Gorry and Scott Morton [GoS71] have already built a framework for managerial activities based on these two variables. This framework is used as the basis for the classification scheme. The purpose of this classification scheme is two fold -

* To compare and integrate the existing studies on a common set of criteria, and
* To develop an integrated set of experiments for each of the nine cells.

4.3 Criteria

The following criteria were considered to assign the individual studies to each cell:

1. Frequency at which the decision should be made
2. Percentage of quantifiable information
3. Planning horizon
4. Duration of decision impact
5. No. of functions involved

Rankings of low, medium and high were used to make a study fit into a particular cell. The rankings for each criteria for each cell is as given in Table 1.

For example, in the experiment conducted by Benbasat and Schroeder [BeS77] the decision had to be made in sequential time periods at a high frequency. The decisions were with respect to production and inventory levels and the information was highly quantifiable. The planning horizon and the duration of the decision impact were low. The functions involved were mainly production and materials. Hence this study was assigned to the lower level-structured cell.

TABLE 1

Rankings for each criteria for each cell

	Structured	Semi-Structured	Unstructured
Top	1. L 2. H-M 3. H-M 4. H 5. H	1. L 2. M-L 3. H 4. H 5. H	1. L 2. L 3. H 4. H 5. H
Middle	1. M 2. H 3. M 4. M 5. M	1. M 2. H-M 3. M 4. H-M M 5. M	1. M-L 2. M 3. M 4. H-M 5. H-M
Lower	1. H 2. H 3. L 4. L 5. L	1. H-M 2. H 3. M-L 4. M 5. L	1. M 2. H-M 3. M 4. H-M 5. M-L

4.4 Taxonomy of existing literature

The above mentioned taxonomy and criteria are used to categorize the existing literature to one or more of the nine cells. Table 2 depicts which study falls within each cell of the taxonomy. It is evident that most researchers have focused on structured decisions and/or decisions at the operational level. A detailed summary of the taxonomy is given in Appendix 1.

TABLE 2

Taxonomy of Existing Studies

	Structured	Semistructured	Unstructured	# of Studies
Top	[Luc81]			1
Middle	[BDT86] [BeD85] [BeD86] [Luc81] [Rem87] [Zmu78]	[BDT86] [DeJ85]	[BDT86] [JaD85]	10
Lower	[BeS77] [DDM86] [Gha81] [Lau86] [LuK79] [Pet82] [PLS84] [Rem84] [Rem87] [Tul81] [UmS88] [WaD83] [Zmu78]	[Dav81] [DDM86] [LuN80]	[DDM86]	17
# of Studies	20	5	3	

5.0 EXPERIMENTAL DESIGN

5.1 Design Framework

Dickson et al. [DDM86] varied the nature of tasks from structured to unstructured decisions, across three decision categories by increasing the number of variables to be processed as the decision becomes less structured. Benbasat et al. [BDT86] had a constant task domain (Brand Manager's Allocation Problem) for their three experiments. This research experiment takes into account the experimental design of the above two studies.

For each level of managerial activity, irrespective of structure, a specific task activity is identified. The structure is then varied by changing the number of variables to be processed. A structured decision will involve less variables, with the number of variables increasing as one moves towards an unstructured decision.

5.2 Task Environment

The task environment for all the nine cells includes an evaluation of the emergency medical services provided by a hypothetical ambulance firm AMBUCARE. AMBUCARE is currently located in eight areas (dispatch locations) in a city (Appendix 2). Each dispatch unit services the areas within its grid. The operation of the firm is centralized.

The decision to be made for each level of managerial activity are:

Top	-	Location of an additional dispatch location
Middle	-	Redistribution of dispatch locations (change in existing grid format)
Lower	-	Resource allocation (vehicles) among dispatch locations.

5.3 Experiments

The subjects in the following three experiments are required to make a certain decision given the demand (number of calls). The calls are split into emergency and non-emergency calls. The demand for each dispatch location and for all dispatch locations together is given in either tables or graphs. The service objective of AMBUCARE is to provide fast service for emergency calls.

5.3.1 Cell I Experiment (Lower-Structured)

In this experiment the subjects are required to decide as to how many and what type of vehicle should be assigned to each dispatch location, given the demand (number of calls). The details of the experiment are given in Appendix 3.

5.3.2 Cell II Experiment (Middle-Structured)

In this experiment, the subjects are required to redistribute the dispatch locations (change the original grid format), given the demand (number of calls). The details of the experiment are given in Appendix 4.

5.3.3 Cell III Experiment (Top-Structured)

In this experiment, the subjects have to decide whether to locate an additional dispatch location and if so, where to locate it, given the demand (number of calls). The details of the experiment are given in Appendix 5.

5.4 Future Experiments

The future experiments will be designed for the semi-structured and the unstructured columns.

The subjects in the following three experiments will be required to make a certain decision given the demand (number of calls) and the average response time for each service area grouped by dispatch location. The task complexity is increased from the previous experiments by the addition of another variable - response time.

5.4.1 Cell IV Experiment (Lower-Semistructured)

In this experiment the subjects will decide as to how many and what type of vehicle should be assigned to each dispatch location, given the demand (number of calls) and the average response time.

5.4.2. Cell V Experiment (Middle-Semistructured)

In this experiment the subjects will redistribute the dispatch locations (change the original grid format), given the demand (number of calls) and the average response time.

5.4.3. Cell VI Experiment (Top-Semistructured)

In this experiment the subjects will decide whether to locate an

additional dispatch location and if so, where to locate it given the demand (number of calls) and the average response time.

Finally, for the unstructured column, the task complexity will be increased further by given the cost figures along with the demand and response time. The following three experiments pertain to this column.

5.4.4 Cell VII Experiment (Lower-Unstructured)

In this experiment the subjects will assign the number and type of vehicles to each dispatch location given the demand (number of calls), average response time and the cost.

5.4.5 Cell VIII Experiment (Middle-Unstructured)

In this experiment the subjects will redistribute the dispatch locations (change the original grid format), given the demand (number of calls), average response time and the cost.

5.4.6. Cell IX Experiment (Top-Unstructured)

In this experiment the subjects will decide whether to locate an additional dispatch location and if so, where to locate it, given the demand (number of calls), average response time and the cost.

6.0 CONCLUSIONS AND FUTURE STEPS

6.1 Conclusions

The review of previous studies reveals that most studies have concentrated on structured decisions and/or decisions at the lower managerial level. In our review a majority of the studies could be assigned only to one cell, with the exception of a few that were assigned to more than one cell. Two studies ([BDT86], [DDM86]) were assigned to three cells in a row, with [BDT86] occupying the middle level and [DDM86] occupying the lower level of managerial activity across the structured-unstructured continuum. Thus, it can be seen that there is a diversity of studies in this area but no common basis for comparing them. Hence, we developed this taxonomy based on the Gorry and Scott Morton's [GoS71] framework to provide a basis for comparison of existing studies, depending on the task characteristics. It is intended that this taxonomy will help alleviate the contradictory findings in the mode of presentation area. It is suggested that comparison in future, be made only between those studies that fall within a cell. Our research covers all nine cells, and the experimental results of each cell will be compared only with the existing studies already in that cell.

6.2 Future Steps

We intend to pursue the following steps in the future:

1. **New task environment:** Having run the experiments with the AMBUCARE task environment and recording the results, we intend conducting experiments with another task environment (financial or marketing) to validate our findings.

2. **Different graphical formats:** Recently, Jarvenpaa [Jar89] has evaluated the effectiveness of different graphical (attribute bar chart, alternative bar chart and grouped bar chart) formats across varying task environments. If we find that graphs are effective for a specific cell, we will extend this research to compare different graphical formats.

3. **Extend the time frame:** Since many decision makers are exposed to the same reports periodically, we will study the impact of information presentation mode over multi-periods to gauge the changes in decision effectiveness over time.

REFERENCES

[BDT86] Benbasat, I., Albert S. Dexter, and Peter Todd. "An Experimental Program Investigating Color-Enhanced and Graphical Information Presentation: An Integration of the Findings," Communications of the ACM, Volume 29, Number 11, pp. 1094-1105.

[BeD85] Benbasat, I., and Albert S. Dexter. "An Experimental Evaluation of Graphical and Color-Enhanced Information Presentation," Management Science, Volume 31, Number 11, (November 1985), pp. 1348-1364.

[BeD86] Benbasat, I., and Albert S. Dexter. "An Investigation of the Effectiveness of Color and Graphical Information Presentation Under Varying Time Constraints," MIS Quarterly, Volume 10, Number 1, (March 1986), pp. 59-80.

[BeS77] Benbasat, I., and R. Schroeder. "An Experimental Investigation of Some MIS Design Variables," MIS Quarterly, Volume 1, Number 1, (1977), pp. 37-49.

[Dav81] Davis, D.L. "An Experimental Investigation of the Form of Information Presentation, Psychological Type of The User, and Performance Within the Context of a Management Information System," Ph.D. Dissertation, University of Florida, (March 1981).

[DDM86] Dickson, G.W., Gerardine DeSanctis, and D.J. McBride. "Understanding the Effectiveness of Computer Graphics for Decision Support: A Cumulative Experimental Approach," Communications of the ACM, Volume 29, Number 1, (January 1986), pp. 40-47.

[DeJ85] DeSanctis G., and Jarvenpaa S.L. "An Investigation of the "tables vs graphs" Controversy in a Learning Environment," Proceedings of the 6th International Conference on Information Systems, Gallegos, L., R. Welke, and J. Wetherbe (Eds.), Indianapolis, Ind., (December 1985), pp. 134-144.

[Des84] DeSanctis, G. "Computer Graphics as Decision Aids: Directions for Research," Decision Sciences, Volume 15, Number 4, (Fall 1984), pp. 463-487.

[DSC77] Dickson, G.W., James A. Senn, and Norman L. Chervany. "Research in Management Information Systems: The Minnesota Experiments," Management Science, Volume 23, Number 9, (May 1977), pp. 913-923.

[Er 88] Er, M.C. "Decision Suppport Systems: A Summary, Problems and Future Trends," Decision Support Systems, Volume 4, (1988), pp. 355-363.

[Gaf81] Gafner, M.K. "Computer Graphics: Looking Sharp for the Eighties," Administrative Management, (May 1981), pp. 29-31.

[Gha81] Ghani, J.A. "The Effects of Information Presentation and Modification on Decision Performance,", Ph.D. Dissertation, University of Pennsylvania, (1981).

[GoS71] Gorry, G.A., and M.S. Scott Morton. "A Framework for Management Information Systems," Sloan Management Review, Volume 13, Number 1, (Fall 1971), pp. 55-70.

[Hub83] Huber, G.P. "Cognitive Style as a Basis for MIS and DSS Designs: Much Ado About Nothing," Management Science, Volume 29, Number 5, (May 1983), pp. 567-579.

[Ive82] Ives, B. "Graphical User Interfaces for Business Information Systems," MIS Quarterly Special Issue, (1982), pp. 15-47.

[JaD85] Jarvenpaa, S.L., and G.DeSanctis. "An Empirical Investigation of the Summarizing Ability of Graphics," Proceedings of the American Institution for Decision Sciences, (November 1985), pp. 347-349.

[JaD88] Jarvenpaa, S.L., and Gary W. Dickson. "Graphics and Managerial Decision Making: Research Based Guidelines," Communications of the ACM, Volume 31, Number 6, (June 1988), pp. 764-774.

[JDD85] Jarvenpaa, S.L., and Gary W. Dickson, and Gerardine DeSanctis. "Methodological Issues in Experimental IS Research: Experiences and Recommendations," MIS Quarterly, Volume 9, Number 2, (June 1985), pp. 141-156.

[Jar81] Jarett, I.M. "Computer Graphics: A Reporting Revolution?," Journal Of Accountancy, (May 1981), pp. 46-57.

[Jar86] Jarvenpaa, S.L. "The Investigation of the Effects of Choice Tasks and Graphics on Information Processing Strategies and Decision Making Performance," Ph.D. Dissertation, University of Minnesota, (1986).

[Jar89] Jarvenpaa, S.L. "The Effect of Task Demands and Graphical Format on Information Processing Strategies," Management Science, Volume 35, Number 3, (March 1989), pp. 285-303.

[KiR78] King, W.R., and Jaime I. Rodriguez. "Evaluating Management Information Systems," MIS Quarterly, Volume 2, Number 3, (September 1978), pp. 43-51.

[Lau86] Lauer, T. W. "The Effects of Variations in Information Complexity and Form of Presentation on Performance for an Information Extraction Task," Ph.D. Dissertation, Indiana University, (1986).

[Luc81] Lucas, H.C.,Jr. "An Experimental Investigation of the Use of Computer-Based Graphics in Decision Making," Management Science, Volume 27, Number 7, (July 1981), pp. 757-768.

[LuK79] Lusk, E.J., and M. Kersnick. "The Effects of Cognitive Style and Report Format on Task Performance: The MIS Design Consequences," Management Science, Volume 25, Number 8, (August 1979), pp. 787-798.

[LuN80] Lucas, H.C.,Jr., and N.R. Neilsen. "The Impact of the Mode of Information Presentation on Learning and Performance," Management Science, Volume 26, Number 10, (October 1980), pp. 982-993.

[MaM73] Mason, R.O., and Ian I. Mitroff. "A Program For Research on Management Information Systems," Management Science, Volume 19, Number 5, (January 1973), pp. 475-487.

[McE81] McEwan, C.E. "Computer Graphics: Getting More from a Management Information System," Data Management, (July 1981), pp. 30-32.

[MoW88] Montazemi, A.R., and S. Wang. "The Effects of Modes of Information Presentation on Decision-Making: A Review and Meta-Analysis," Journal of Management Information Systems, Volume 5, Number 3, (Winter 1988-1989), pp. 101-127.

[Pal81] Paller, A.T. "Improving Management Productivity with Computer Graphics," IEEE CG&A, (October 1981), pp. 9-16.

[Par89] Parker, C.S. Management Information Systems Strategy And Action, McGraw-Hill Publishing Company, (1989).

[Pet82] Peterson, B.K. "The Effect of Tabular and Graphic Presentation on Reader Retention, Reader Reaction and Reading Time," Ph.D. Dissertation, Northern Illinois University, (1982).

[PLS84] Powers, M., Conda Lashley, Pamela Sanchez, and Ben Shneiderman. "An Experimental Comparison of Tabular and Graphical Data Presentation," Int. J. Man-Machine Studies, Volume 20, (1984), pp. 545-566.

[Rem84] Remus, W. "An Empirical Investigation of the Impact of Graphical and Tabular Data Presentations on Decision Making," Management Science, Volume 30, Number 5, (May 1984), pp. 533-542.

[Rem87] Remus, W. "A Study of Graphical and Tabular Displays and Their Interaction with Environmental Complexity," Management Science, Volume 33, Number 9, (September 1987), pp. 1200-1204.

[RoT82] Robey, D., and William Taggart. "Human Information Processing in Information and Decision Support Systems," MIS Quarterly, Volume 6, Number 2, (June 1982), pp. 61-73.

[SBM88] Sharda, R., Steve H. Barr, and James C. McDonnell. "Decision Support System Effectiveness: A Review and an Empirical Test," Management Science, Volume 34, Number 2, (February 1988), pp. 139-159.

[Sen85] Sen, T.K. "The Effects of Query Response Presentation on Decision Processes," Ph.D. Dissertation, The University of Iowa, (1985).

[StW84] Stock, D., and Collin J. Watson. "Human Judgment Accuracy, Multidimensional Graphics, and Humans versus Models," Journal of Accounting Research, Volume 22, Number 1, (Spring 1984), pp. 192-201.

[Tul81] Tullis, T.S. "An Evaluation of Alphanumeric, Graphic and Color Information Displays," Human Factors, Volume 23, Number 5, (1981), pp. 541-550.

[UmS88] Umanath, N.S., and Richard W. Scamell. "An Experimental Evaluation of the Impact of Data Display Format on Recall Performance," Communications of the ACM, Volume 31, Number 5, (May 1988), pp. 562-570.

[ViG81] Vinberg, A., and James E. George. "Computer Graphics and the Business Execcutive - The New Management Team," IEEE CG&A, (January 1981), pp. 57-71.

[WaD83] Watson, C.J., and R.W. Driver. "The Influence of Computer Graphics on the Recall of Information," MIS Quarterly, Volume 7, Number 1, (March 1983), pp. 45-53.

[Yan87] Yang, Cheng-Fu. "The Impact of Computer-Based Graphics on Decision-Making in Business Organizaitons," Ph.D. Dissertation, United States International University, (1987).

[ZBM83] Zmud, R.W., E. Blocher, and R.P. Moffie. "The Impact of Color Graphic Report Formats on Decision Performance and Learning," Proceedings of the Fourth International Conference on Information Systems, Chicago, IL: Society of Information Management, (1983).

[Zmu78] Zmud, R.W. "An Empirical Investigation of the Dimensionality of the Concept of Information," Decision Sciences, Volume 9, Number 2, (October 1978), pp. 187-195.

[Zmu79] Zmud, R.W. "Individual Differences and MIS Success: A Review of the Empirical Literature," Management Science, Volume 25, Number 10, (October 1979), pp. 966-979.

APPENDIX 1

SUMMARY OF RESEARCH FINDINGS

SUMMARY OF RESEARCH FINDINGS

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Benbasat & Schroeder (1977)	Inventory/Prod. Gaming Environment	Single Product: 1. Inv. Order Pt. 2. Inv. Order Qty. 3. Daily Production Figs.	S SS US T M L *	Tables vs Graphs (CRTs' used)	1. Form of presentation 2. Decision making aids 3. Exception reporting 4. No. of reports available 5. Decision making style 6. Knowledge of functional area	1. Cost Performance 2. Time Performance 3. No. of reports requested	_ Graphs better _ ? _ Graphs better
Zmud (1978)	Lab setting: General data	Middle-lower management type of decision	S SS US T M * L *	Tables & Bar charts & Line Graphs	Form of presentation	1. Preference/ perceived relevance	Line graphs better over tables & bar charts Bar charts least preferred

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Lusk & Kersnick (1979)	Field experiment: Annual income of professionals (doctors, lawyers, accountants)	Rank 5 reports according to the perception of the degree of difficulty and answer 20 questions with one of the previously ranked reports	S SS US T M L *	Tables vs Graphs	1. Report format 2. Psychological type (high vs low analytical group)	1. Task performance	Tables better - less complex
Lucas & Nielsen (1980)	Logistics management game	Single Product: Maximize profit through increasing sales volume, while reducing unit logistics cost	S SS US T M L *	Graphs & Tables (CRTs' used)	1. Amount of information 2. CRT vs teletype media 3. Form of report presentation 4. User background differences	1. Performance 2. Rate of performance change	Graphics - no support for performance or learning Superiority of CRT received some support

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Lucas (1981)	Simulation exercise: Inventory re_order	Single product: Selecting quart_erly reorder quantities for an importer under conditions of uncertain demand	S SS US T * M * L	Graphical vs Tabular data vs Tables & graphs (CRTs' used)	1.Type of terminal ouput (Hard copy termi_nal vs CRT) 2.Decision style (Heuristic vs Analytical) 3.Form of presen_tation	1.Performance 2.Usefulness of information 3.Tests of problem understanding	Limited support for use of graphics CRT - no support
Tullis (1981)	Field setting: Computer-based telephone line testing system	Decision about the nature of the problem on the telephone line and action needed to correct it	S SS US T M L *	Narrative vs Tables vs Black & white graphics vs Color graphics	1.Form of presen_tation	1.Speed 2.Accuracy 3.Preference	_Graphs better (no difference between black & white and color) _No effect _Color graph preferred to black & white

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Davis (1981)	Simulation exercise: Production environment	Single product: Role of production manager to make a number of sequential decisions for levels of production, so as to minimize cost for a simulated year of production	S SS US T M L *	Graphical vs Tabular data	1. Report type 2. Data type: statistical vs raw data 3. Psychological type: sensitive thinking; intuitive thinking; sensitive feeling; intuitive feeling	1. Cost performance 2. Confidence 3. Decision time	Graphs & tables had no effect on cost, confidence and time Best format varied across user type Raw data preferred over summarized data
Ghani (1981)	Lab setting: Simulated marketing environment - Inventory ordering	Role of owner of a pizza truck, to decide on how many frozen pizzas to take to a weekend resort town, given the weekend weather forecast and probability density of daily demand	S SS US T M L *	Tables vs Graphs (Graphics terminal used)	1. Form of presentation 2. Change in information presentation	1. Profits attained 2. Decision time 3. User preference	_Tabular better but profits declined after change in information _Tabular better but time increased after information change _Feeling types prefer graphics; Thinking types prefer tables But format prior to change preferred

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Peterson (1982)	Field Setting: Read reports on "Trends in Employment"	Subjects to answer 24 multiple choice questions pert_ aining to report	S SS US T M L *	Narratives vs Graphs vs Tables	1.Form of presentation (Narratives, Tables & Narratives, Graphs & Narratives, Graphs & Tables & Narratives) 2.Sex 3.Academic major 4.GPA 5.Learning style	1.Reader retention 2.Reader reaction 3.Reading time	_Tables with narratives best _Positive for narratives & graphs _Narratives & tables took least time
Lauer (1986)	Lab setting: Time-series information of a financial nature (profit, market share etc.) for different companies	Answer questions about information in one of the presentations	S SS US T M L *	Graphs vs Tables	1.Form of presentation (line graphs, bar charts, pie charts, tables) 2.Complexity of information (8 levels) 3.Difficulty of question (control variable)	1.Performance 2.Time to answer questions 3.Accuracy of answer	_Tables superior _Increase in complexity of information lead to decrease in time perform_ ance except for pie charts

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Watson & Driver (1983)	Lab setting: Geographic location of physicians	Rank order (highest to lowest relative frequency) a list of six states in terms of the % of physicians located in the state	S SS US T M L *	3D graphical maps vs Tabular data	1. Mode of presentation	1. Immediate recall 2. Delayed recall	Graphs not superior to tabular presentation in both cases
Remus (1984)	Lab setting: Production scheduling problem	Production & work force decisions for 24 periods	S SS US T M L *	Tables vs Graphs	1. Work force size 2. Production level 1. Work force size 2. Overtime/idle costs 3. Cost of inventory	1. Linear cost 2. Quadratic cost	Tabular display yielded lower cost than graphical display

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Powers, Lashley, Sanchez & Shneiderman (1984)	Lab setting: Academic test results; students	Respond to multiple choice questions based on 20 test scores	S SS US T M L *	Graphs vs Tables vs Graphs & Tables	1. Memory (recall vs non_recall) 2. Form of presentation	1. Comprehension 2. Accuracy	Tables superior to both graphs & graphs & tabular data
Benbasat & Dexter (1985)	Lab experiment: Brand manager's allocation problem decision making)	Allocation of a fixed promotional budget across 3 marketing territories so as to maximize profits	S SS US T M * L	Graphical vs Tabular data	1. Information System: Graphs vs Tables 2. Color: Mono vs multi color 3. Individual difference: Field dependent vs Field independent	1. Profit performance 2. Time performance 3. Report attribute ratings	_No differnce between tables & graphs _No difference _Tabular reports better formatted Graphs more relevant & more useful for formulating solutions

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
DeSanctis & Jarvenpaa (1985)	Lab setting: Financial/Accounting context	Develop financial forecasts for fictitious companies over 5 experimental trials	S SS US T M * L	Tables vs Graphs	1. Form of presentation (tabular spreadsheet, graphs with standard scaling, graphs with non-standard scaling) 2. Experimental trials (5)	1. Decision quality 2. Confidence	Graphs better than tables after 5 trials Performance better with standard scaling
Jarvenpaa & DeSanctis (1985)	Lab experiment: Business case setting	Subjects play role of consultant to help CEO find reason for falling profits at a time of increasing sales	S SS US T M * L	Tables vs Graphs	1. Form of presentation 2. Information load (low vs high) 4. User background differences	1. Decision quality 2. Time 3. Decision confidence 4. Satisfaction 5. Interpretation accuracy 6. Perception	_No significant difference between tables & graphs _No significant differnce _No significant difference _No consistent pattern of results _No consistent pattern of results _No consistent pattern of results

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Dickson, DeSanctis & McBride (1986)	Lab Experiments: 1. Financial/ Accounting context	Play the role of a bank officer & determine if a firm is qualified for a loan	S SS US T M L *	Graphical vs Tabular data	1. Task environment 2. Mode of presentation	1. Readability 2. Interpretation accuracy 3. Decision quality	_Graphs more difficult to read _No difference _No difference
	2. Market demand forecasting problem	Chemical manufacturer to forecast demand for 3 of its products given demand histories	S SS US T M L *	Line plots vs Tables	1. Task environment 2. Mode of presentation	1. Data interpretation 2. Decision quality	_No difference _Subjects with graphs outperformed those with tables
	3. General managerial context	Evaluate the quality of a research firm's final report on a survey of users of computer graphics	S SS US T M L *	Graphs vs Tables	1. Task environment 2. Mode of presentation 3. Complete vs subset presentation	1. Interpretation accuracy 2. Decision quality	Graphs outperformed tables only were vast amount of information was presented

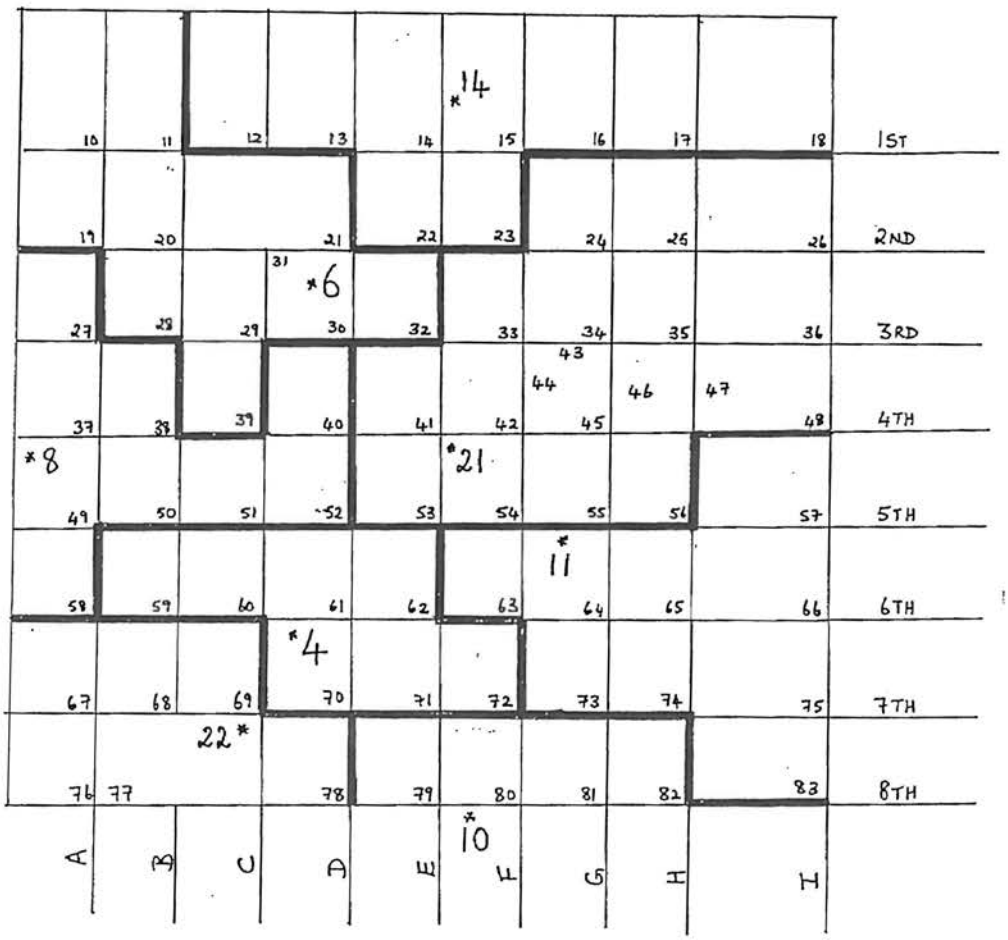
STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Benbasat, Dexter, & Todd (1986)	Lab setting: 1. Promotional Budget Allocation	Allocate budget among 3 territories making decisions over multiple periods to maximize total profit over 10 decisions	S SS US T M * L	Tables vs Graphs	1. Information presentation 2. Color: mono vs multicolor 3. Individual difference: (field dependent vs field independent)	1. Profit performance 2. Time performance 3. Report ratings	_No significant difference _No significant difference _Tablular - more accurate & better formatted Graphs - more relevant
	2. Promotional Budget Allocation	Decision making through use of simulation to find one optimal solution	S SS US T M * L	Tables vs Graphs	1. Information presentation 2. Color: mono vs multicolor	1. Report usage 2. Time 3. No. of trials 4. Profit performance 5. Report rating	_Tables > graphs _No significant difference _Graphs > Tables _No significant difference
	3. Promotional Budget Allocation	Decision making through the analysis of one simple report to find one optimal solution graphics	S SS US T M * L	Graphs vs Tables vs Graphs & tables	1. Information presentation 2. Mode of presentation 3. Complete vs subset presentation	1. Profit tion accuracy 2. Decision time 3. Ratings	_No significant diff. (5 min.) _Combined > table > graph (15 min.) _No significant diff. (5 min.) _Graphs better (15 min) _Accuracy - Combined report best

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Benbasat & Dexter (1986)	Lab experiment: Brand Manager's Allocation Problem	Allocation of fixed promotional budget across 3 territories with the object_ ive of maximizing profits	S SS US T M * L	Tables vs Graphs vs Combined tables & graphs	1. Information presentation 2. Color: monochromatic vs multicolor 3. Time const_ raint: Low vs High	1. Profit performance 2. Time taken 3. Report attribute ratings	Combined report was superior in terms of perfor_ mance and was rated very highly
Remus (1987)	Lab setting: Production scheduling problem	Production & work force decisions for first 12 periods (learning phase) and the last 12 periods (stable phase)	S SS US T M * L *	Tables vs Graphs	1. Task complexity (Low vs Inter_ mediate) 2. Form of presen_ tation 3. Phase (Learning vs Stable)	1. Cost	Tables better in low complex_ ity tasks Graphs better in intermediate complexity tasks

STUDY	CONTEXT/TASK	TYPE OF DECISION	CELL	MODE OF PRESENTATION	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESULTS
Umanath & Scamell (1988)	Lab setting: 1.Work center load profile	Operations oriented decision making - Respond to questionnaire with immediate & delayed time domain	S SS US T M L *	Tables vs Graphs (bar charts)	1. Information presentation 2. Task category: recall of direct order vs pattern recall vs specific fact recall 3. Time: immediate vs delayed	1. Performance	Graphical presentation enhances recall when task posseses a spatial orientation
	2.Work center load profile	Rate their degree of familiarity with graphical & tabular display format - Questions to measure recall performance	S SS US T M L *	Tables vs Graphs (bar charts)	1. Information presentation 2. Task category: pattern integration recall vs simple fact recall	1. Performance	Recall of specific facts is indifferent to data display format

APPENDIX 2

DISPATCH LOCATION GRID



APPROXIMATE SERVICE AREAS FOR 8 LOCATIONS

APPENDIX 3

CELL I EXPERIMENT - LOWER-STRUCTURED

AMBUCARE

AMBUCARE is a hypothetical ambulance firm that provides emergency medical service for a city. The attached grid shows the 8 dispatch locations of AMBUCARE and the areas serviced by each location. Its operation is centralized and its customers include members, hospitals, non-members, police etc. AMBUCARE has a variety of vehicles to respond to emergency and non-emergency calls. The type, purpose and number of the vehicles are as given below:

Vehicle Type	Purpose	#
ALS - Advanced Life Support	Used for emergency calls and includes oxygen	31
ILS - Intermediate Life Support	Used for all calls and does no include oxygen	18
ERV - Emergency Response Vehicle	Answer calls but do not transport patients	4
DAC - Demand Aid Cars	Non-emergency transport vehicles to transport persons who may need medical transport but for whom no medically threatening condition exists	44

AMBUCARE would like to assign the required type and number of vehicles to each location so as to achieve company service objectives. The service objectives focus on fast service for emergency calls. The demand (number of calls) for each dispatch location and for all dispatch locations together is given in the attached tables(graphs).

Please answer the following questions from the data provided in the tables(graphs).

1. Rank order (in descending order) the dispatch locations on the basis of total number of calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

2. What is the grand total of all calls for all dispatch locations? (Round off to nearest 10). _____

3. Calculate the percentage of total calls of the grand total for each dispatch location.

Location	%
14	
6	
21	
8	
11	
4	
22	
10	

4. Rank order (in descending order) the dispatch locations on the basis of number of emergency calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

5. Calculate the percentage of emergency calls of the total calls for each dispatch location.

Location #	%
14	
6	
21	
8	
11	
4	
22	
10	

6. Classify the above dispatch locations in the following class intervals of percentages.

Interval (%)	Location #s'
21-30	
31-40	
41-50	
51-60	
61-70	
71-80	
81-90	

7. Check the service areas which have less than 10 emergency calls on the grid for all dispatch locations.

8. Check the service areas that have more than 100 emergency calls on the grid for all dispatch locations.

9. What is the grand total of all emergency calls for all locations? (Round off to nearest 10).

---

10. Calculate the percentage of emergency calls of the grand total of emergency calls for each dispatch location.

Location #	%
14	
6	
21	
8	
11	
4	
22	
10	

11. Rank order (ir descending order) the dispatch locations on the basis of non-emergency calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

12. Check the service areas that have more than 100 non-emergency calls on the grid for all dispatch locations.

13. Assign the Advanced Life Support (ALS) Vehicles to each dispatch location.

	Location #s								
	14	6	21	8	11	4	22	10	Total
ALS									31

14. Assign the Intermediate Life Support (ILS) Vehicles to each dispatch location.

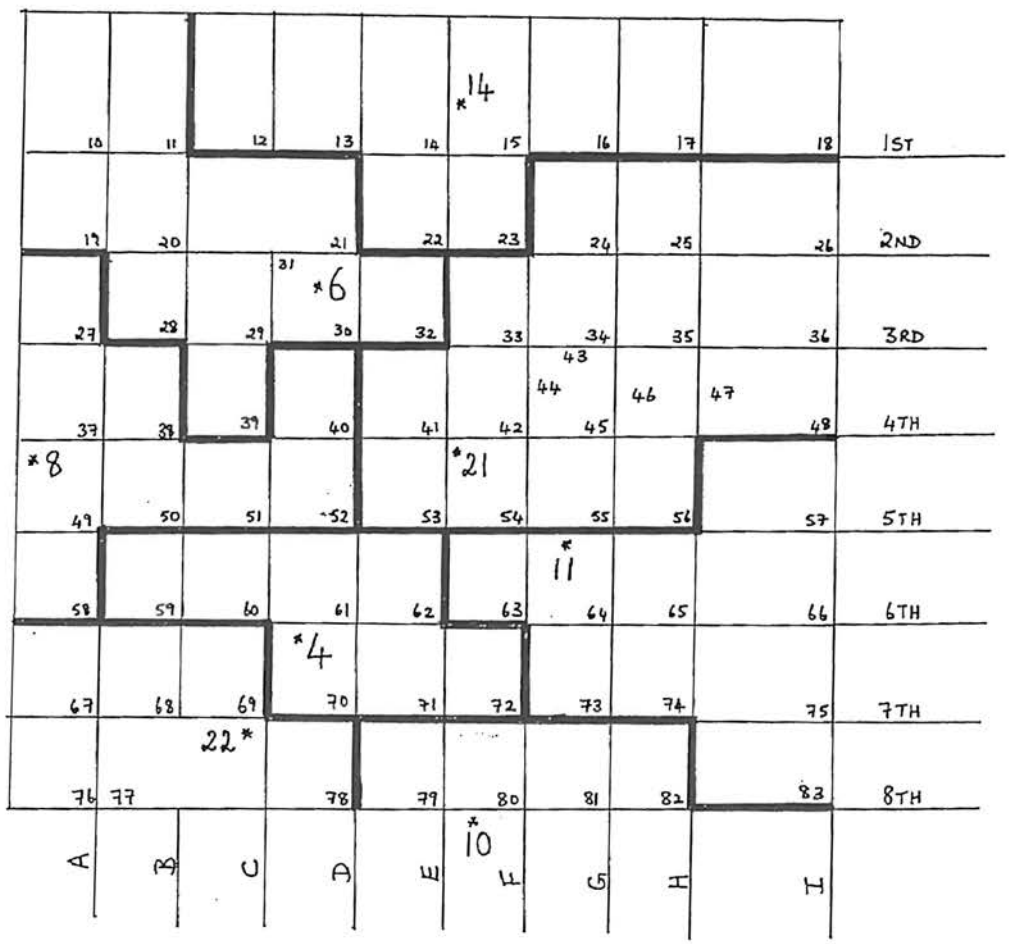
	Location #s								
	14	6	21	8	11	4	22	10	Total
ILS									18

15. Assign the Emergency Response Vehicles (ERV) to each dispatch location.

	Location #s								
	14	6	21	8	11	4	22	10	Total
ERV									4

16. Assign the Demand Aid Cars (DAC) to each dispatch location.

	Location #s								
	14	6	21	8	11	4	22	10	Total
DAC									44



APPROXIMATE SERVICE AREAS FOR 8 LOCATIONS

NUMBER OF CALLS PER DISPATCH LOCATION

ALL LOCATIONS			
LOCATION		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
14	298	244	542
6	982	986	1968
21	1161	879	2040
8	1250	841	2091
11	254	343	597
4	1174	692	1866
22	341	132	473
10	149	36	185

NUMBER OF CALLS PER SERVICE AREA

GROUPED BY DISPATCH LOCATION

LOC ATION 14			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
12	41	49	90
13	96	41	137
14	26	2	28
15	10	9	19
16	18	1	19
17	3	0	3
18	5	0	5
22	93	142	235
23	6	0	6

LOCATION 6			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
10	8	9	17
11	24	32	56
19	90	44	134
20	64	87	151
21	0	0	0
28	108	75	183
29	258	450	708
30	107	64	171
31	126	68	194
32	61	33	94
39	136	124	260

LOCATION 21			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
24	7	1	8
25	2	0	2
26	0	0	0
33	34	41	75
34	5	3	8
35	0	0	0
36	0	0	0
41	196	138	334
42	159	40	199
43	0	0	0
44	6	5	11
45	5	1	6
46	0	0	0
47	3	7	10
48	0	0	0
53	480	429	909
54	234	122	356
55	24	25	49
56	6	67	73

LOCATION 8			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
27	32	13	45
37	189	194	383
38	86	68	154
40	257	313	570
49	68	22	90
50	105	24	129
51	174	89	263
52	319	112	431
58	20	6	26

NUMBER OF CALLS PER SERVICE AREA

GROUPED BY DISPATCH LOCATION

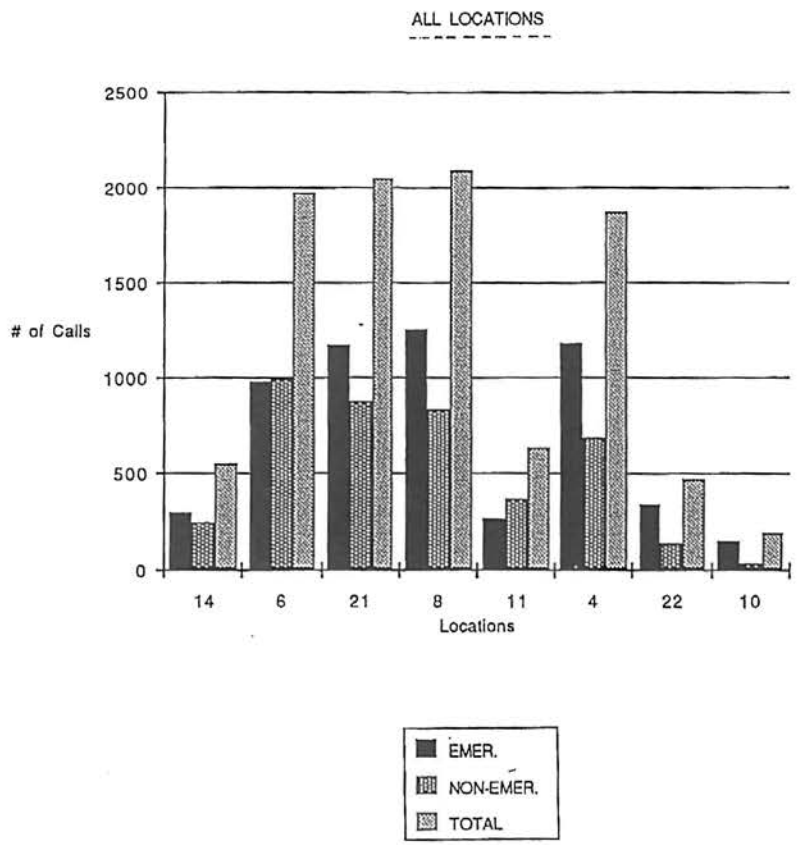
LOCATION 11			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
57	8	26	34
63	83	25	108
64	106	79	185
65	22	158	180
66	5	43	48
73	33	29	62
74	1	4	5
75	2	0	2
83	2	5	7

LOCATION 4			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
59	40	22	62
60	116	23	139
61	192	76	268
62	242	138	380
70	281	221	502
71	232	187	419
72	71	25	96

LOCATION 22			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
67	6	2	8
68	12	1	13
69	122	45	167
76	6	5	11
77	55	19	74
78	140	60	200

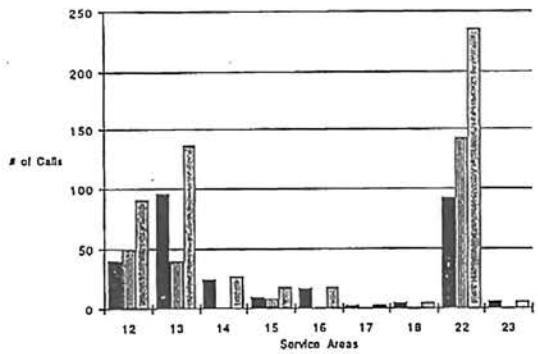
LOCATION 10			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
79	108	30	138
80	33	6	39
81	8	0	8
82	0	0	0

NUMBER OF CALLS PER DISPATCH LOCATION

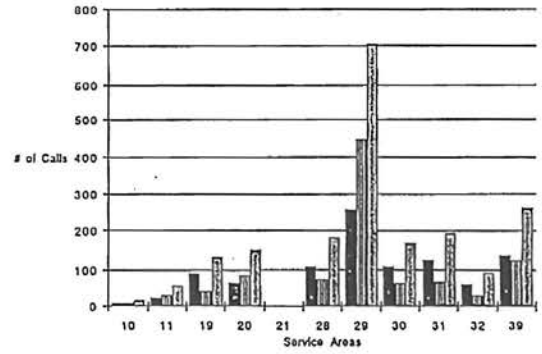


NUMBER OF CALLS PER SERVICE AREA GROUPED BY DISPATCH LOCATION

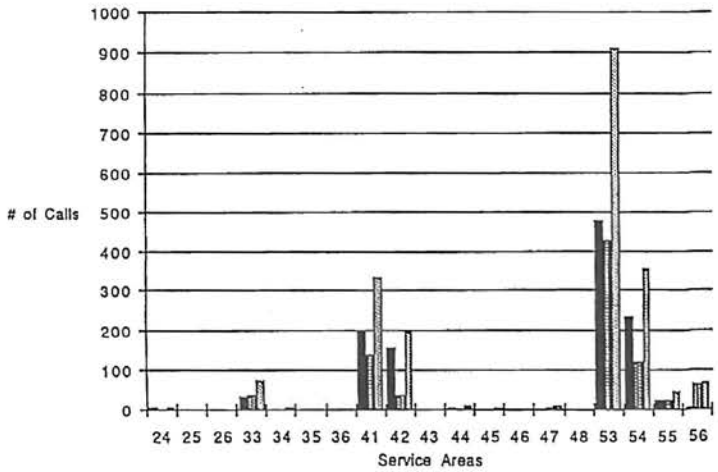
LOCATION 14



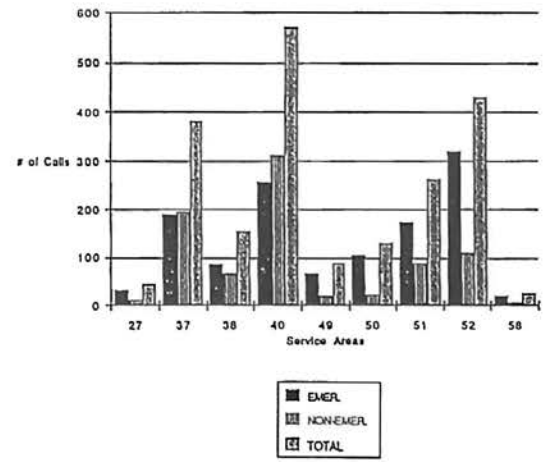
LOCATION 6



LOCATION 21

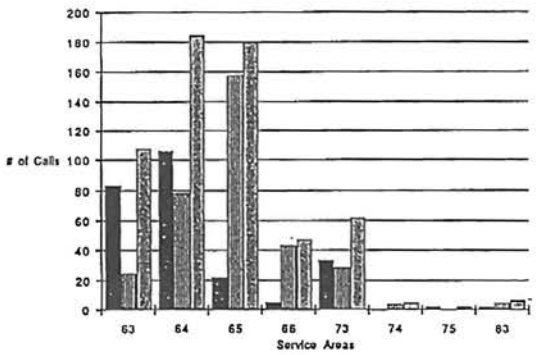


LOCATION 8

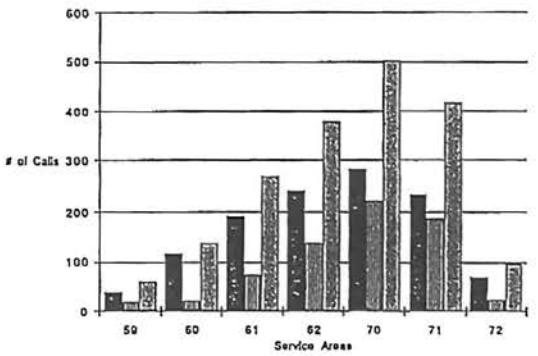


NUMBER OF CALLS PER SERVICE AREA GROUPED BY DISPATCH LOCATION

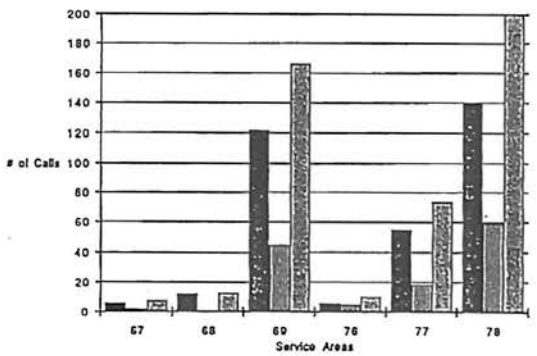
LOCATION 11



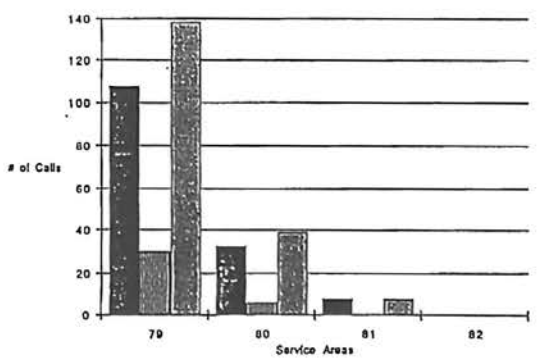
LOCATION 4

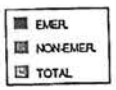


LOCATION 22



LOCATION 10





APPENDIX 4

CELL II EXPERIMENT - MIDDLE-STRUCTURED

AMBUCARE

AMBUCARE is a hypothetical ambulance firm that provides emergency medical service for a city. The attached grid shows the 8 dispatch locations of AMBUCARE and the areas serviced by each location. The operation of AMBUCARE is centralized and its customers include members, hospitals, non-members, police etc. AMBUCARE has a variety of vehicles to respond to emergency and non-emergency calls.

AMBUCARE would like to redistribute its dispatch locations (change the original grid format) so as to achieve company service objectives. The service objectives focus on fast service for emergency calls. The demand (number of calls) for each dispatch location and for all dispatch locations together is given in the attached tables(graphs).

Please answer the following questions from the data provided in the tables(graphs).

1. Rank order (in descending order) the dispatch locations on the basis of total number of calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

2. Rank order (in descending order) the dispatch locations on the basis of number of emergency calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

3. Are the first four dispatch locations ranked above, located near each other? (Yes/No).
   ---

4. Check the service areas which have less than 10 emergency calls on the grid for all dispatch locations.

5. Check the service areas that have more than 100 emergency calls on the grid for all dispatch locations.

6. List service areas that have more than 200 but less than 300 emergency calls for all dispatch locations.

---

7. List service areas that have more than 300 emergency calls for all dispatch locations.

---

8. List the total number of service areas and emergency calls for each location.

Location #	# of Service Areas	Total emergency calls
14		
6		
21		
8		
11		
4		
22		
10		

9. What is the average number of emergency calls per service area for each location?

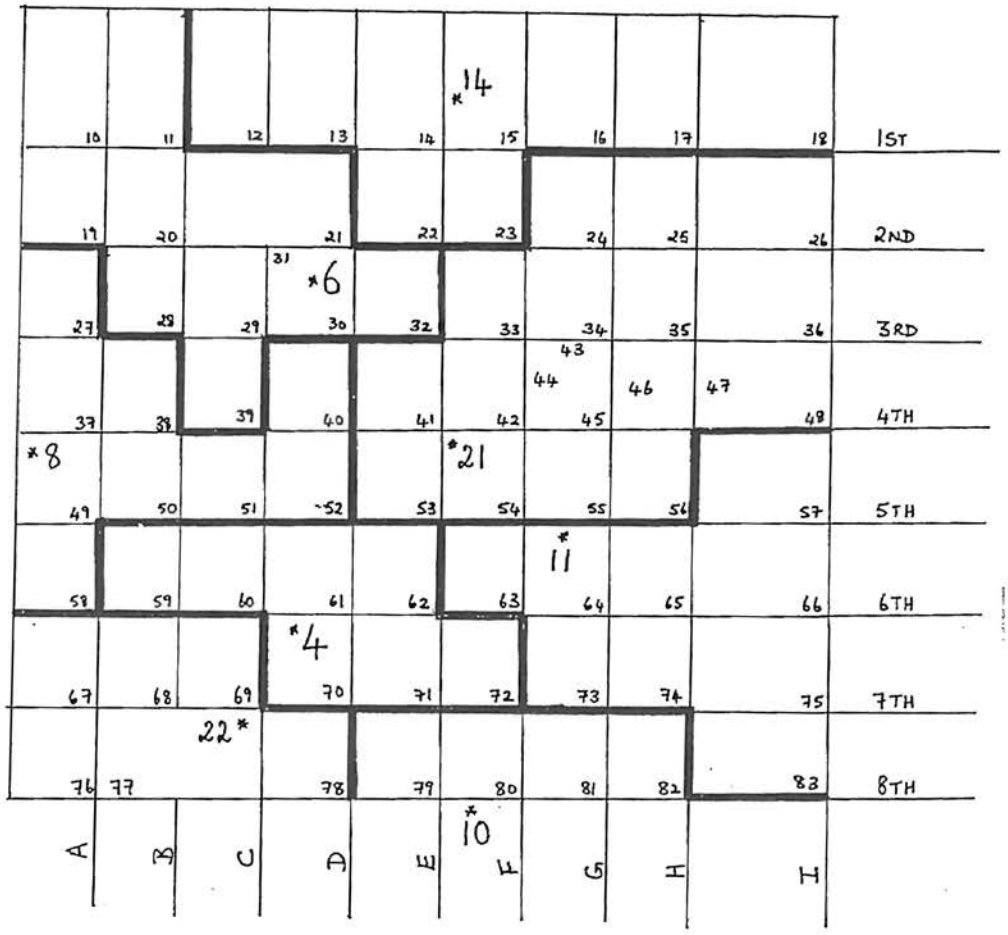
Location #	Avg. # of emergency calls/service area
14	
6	
21	
8	
11	
4	
22	
10	

10. Rank order (in descending order) the dispatch locations on the basis of non-emergency calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

11. Check the service areas that have more than 100 non-emergency calls on the grid for all dispatch locations.

12. Redistribute the dispatch locations (change the original grid format) in the location map provided at the end.



APPROXIMATE SERVICE AREAS FOR 8 LOCATIONS

NUMBER OF CALLS PER DISPATCH LOCATION

ALL LOCATIONS			
LOCATION		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
14	298	244	542
6	982	986	1968
21	1161	879	2040
8	1250	841	2091
11	254	343	597
4	1174	692	1866
22	341	132	473
10	149	36	185

NUMBER OF CALLS PER SERVICE AREA

GROUPED BY DISPATCH LOCATION

LOC ATION 14			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
12	41	49	90
13	96	41	137
14	26	2	28
15	10	9	19
16	18	1	19
17	3	0	3
18	5	0	5
22	93	142	235
23	6	0	6

LOCATION 6			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
10	8	9	17
11	24	32	56
19	90	44	134
20	64	87	151
21	0	0	0
28	108	75	183
29	258	450	708
30	107	64	171
31	126	68	194
32	61	33	94
39	136	124	260

LOCATION 21			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
24	7	1	8
25	2	0	2
26	0	0	0
33	34	41	75
34	5	3	8
35	0	0	0
36	0	0	0
41	196	138	334
42	159	40	199
43	0	0	0
44	6	5	11
45	5	1	6
46	0	0	0
47	3	7	10
48	0	0	0
53	480	429	909
54	234	122	356
55	24	25	49
56	6	67	73

LOCATION 8			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
27	32	13	45
37	189	194	383
38	86	68	154
40	257	313	570
49	68	22	90
50	105	24	129
51	174	89	263
52	319	112	431
58	20	6	26

NUMBER OF CALLS PER SERVICE AREA

GROUPED BY DISPATCH LOCATION

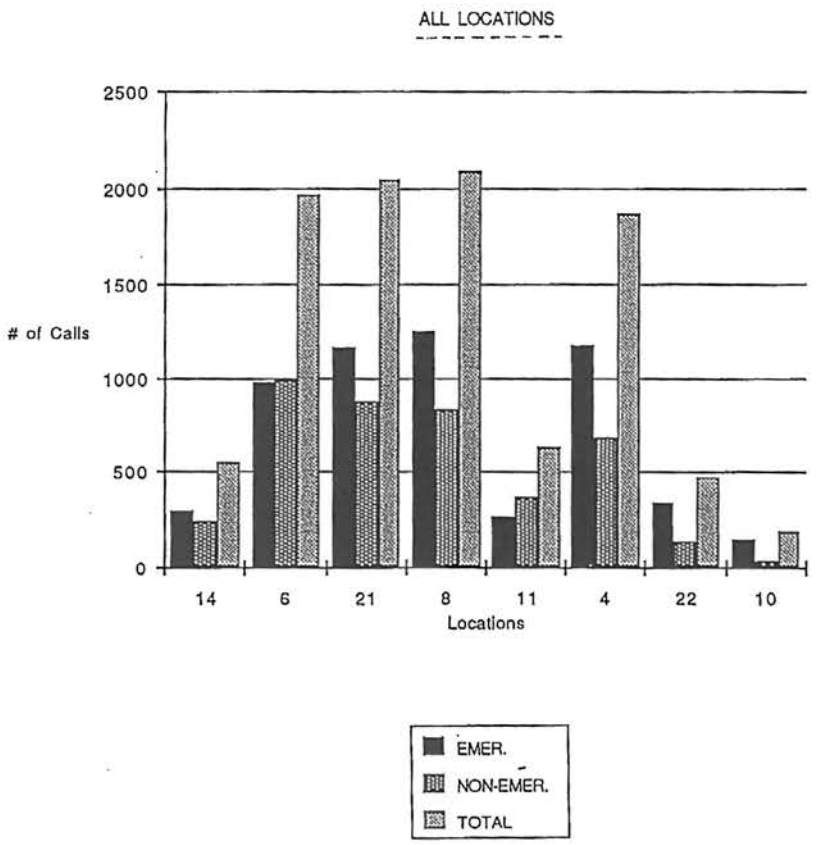
LOCATION 11			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
57	8	26	34
63	83	25	108
64	106	79	185
65	22	158	180
66	5	43	48
73	33	29	62
74	1	4	5
75	2	0	2
83	2	5	7

LOCATION 4			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
59	40	22	62
60	116	23	139
61	192	76	268
62	242	138	380
70	281	221	502
71	232	187	419
72	71	25	96

LOCATION 22			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
67	6	2	8
68	12	1	13
69	122	45	167
76	6	5	11
77	55	19	74
78	140	60	200

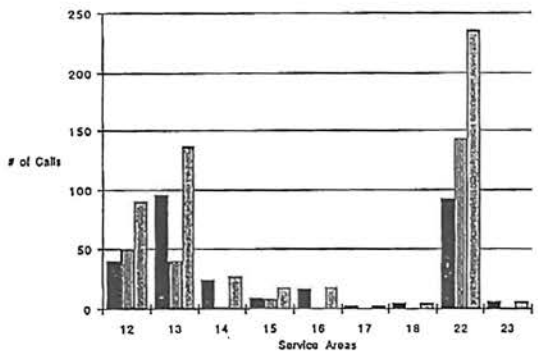
LOCATION 10			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
79	108	30	138
80	33	6	39
81	8	0	8
82	0	0	0

NUMBER OF CALLS PER DISPATCH LOCATION

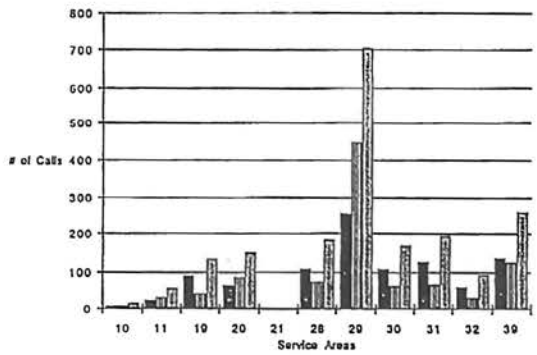


NUMBER OF CALLS PER SERVICE AREA GROUPED BY DISPATCH LOCATION

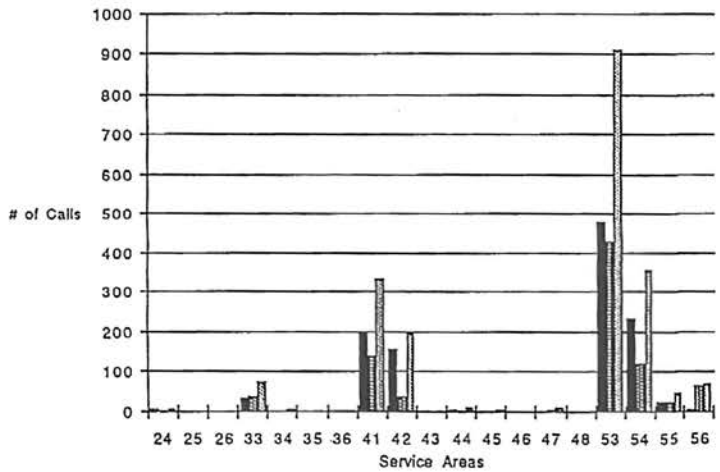
LOCATION 14



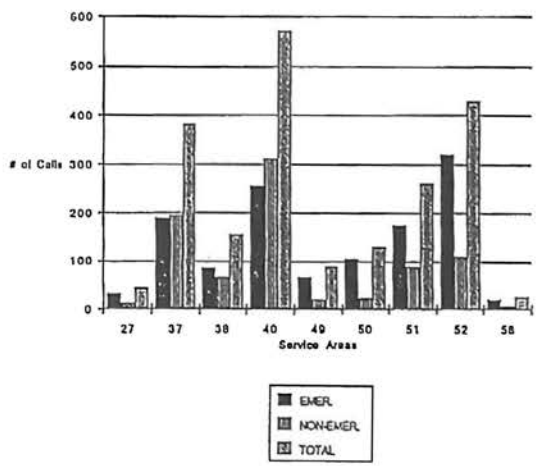
LOCATION 6



LOCATION 21

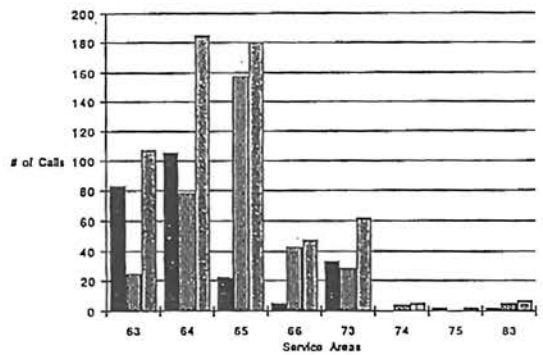


LOCATION 8

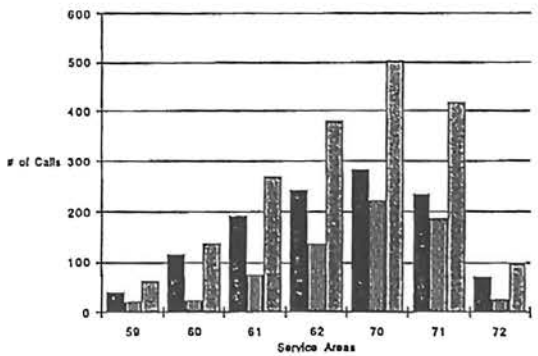


NUMBER OF CALLS PER SERVICE AREA GROUPED BY DISPATCH LOCATION

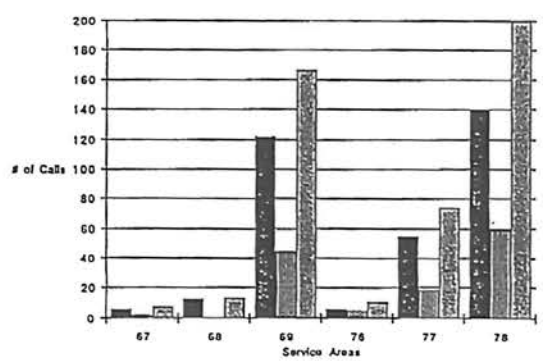
LOCATION 11



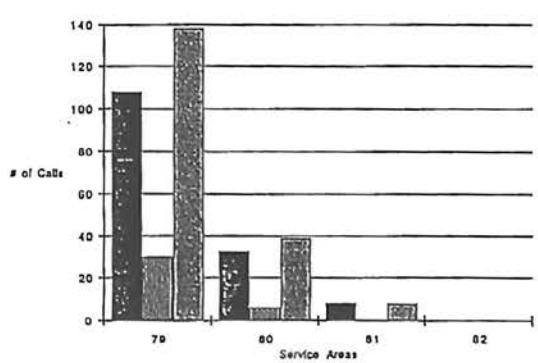
LOCATION 4

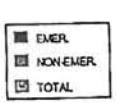


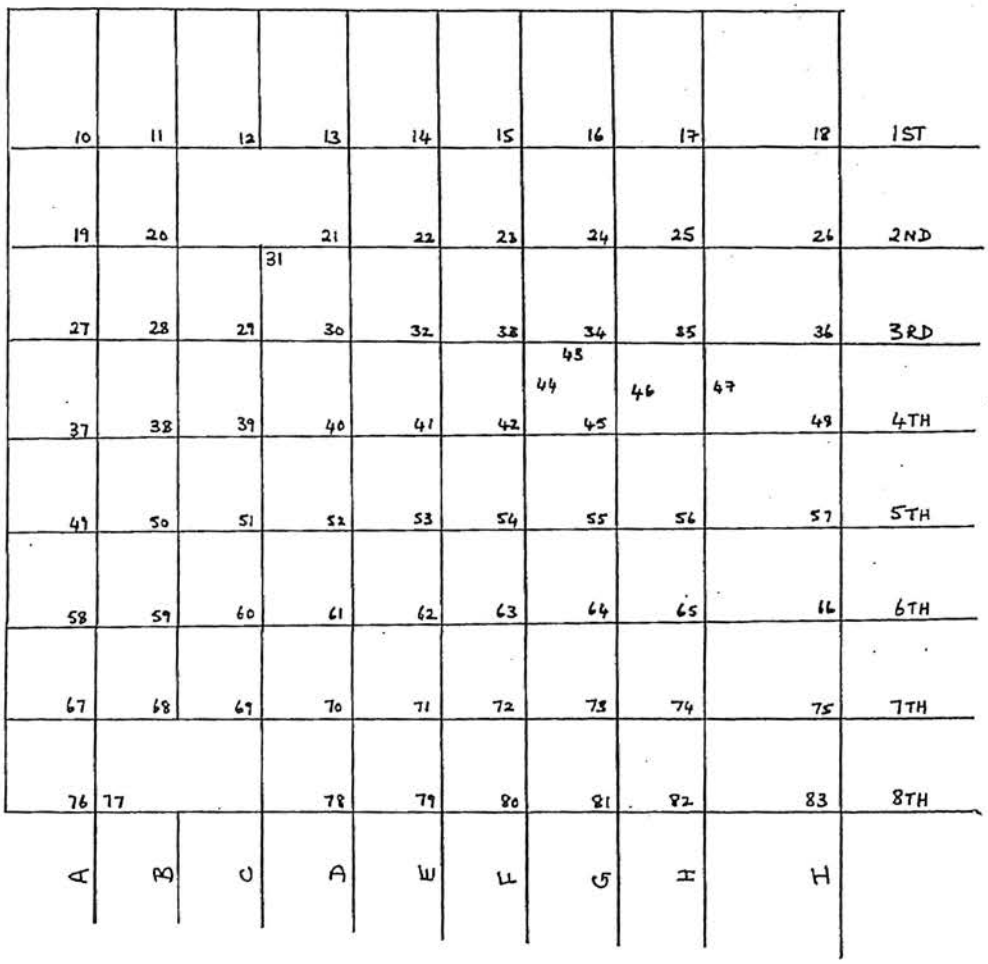
LOCATION 22



LOCATION 10






10 11 12 13 14 15 16 17 18 1ST
19 20 21 22 23 24 25 26 2ND
31
27 28 29 30 32 38 34 35 36 3RD
43
44
46 47
37 38 39 40 41 42 45 48 4TH
49 50 51 52 53 54 55 56 57 5TH
58 59 60 61 62 63 64 65 66 6TH
67 68 69 70 71 72 73 74 75 7TH
76 77 78 79 80 81 82 83 8TH
A B C A W E G H H

APPENDIX 5

CELL III EXPERIMENT - TOP-STRUCTURED

AMBUCARE

AMBUCARE is a hypothetical ambulance firm that provides emergency medical service for a city. The attached grid shows the 8 dispatch locations of AMBUCARE and the areas serviced by each location. The operation of AMBUCARE is centralized and its customers include members, hospitals, non-members, police etc. AMBUCARE has a variety of vehicles to respond to emergency and non-emergency calls.

AMBUCARE would like to allocate a new dispatch location so as to achieve company service objectives. The service objectives focus on fast service for emergency calls. The demand (number of calls) for each dispatch location and for all dispatch locations together is given in the attached tables(graphs).

Please answer the following questions from the data provided in the tables(graphs).

1. Rank order (in descending order) the dispatch locations on the basis of total number of calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

2. Rank order (in descending order) the dispatch locations on the basis of number of emergency calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

3. Are the first four dispatch locations ranked above, located near each other? (Yes/No).
   ---

4. Check the service areas which have less than 10 emergency calls on the grid for all dispatch locations.

5. Check the service areas that have more than 100 emergency calls on the grid for all dispatch locations.

6. List service areas that have more than 200 but less than 300 emergency calls for all dispatch locations.

---

7. List service areas that have more than 300 emergency calls for all dispatch locations.

---

8. List the total number of service areas and emergency calls for each location.

Location #	# of Service Areas	Total emergency calls
14		
6		
21		
8		
11		
4		
22		
10		

9. What is the average number of emergency calls per service area for each location?

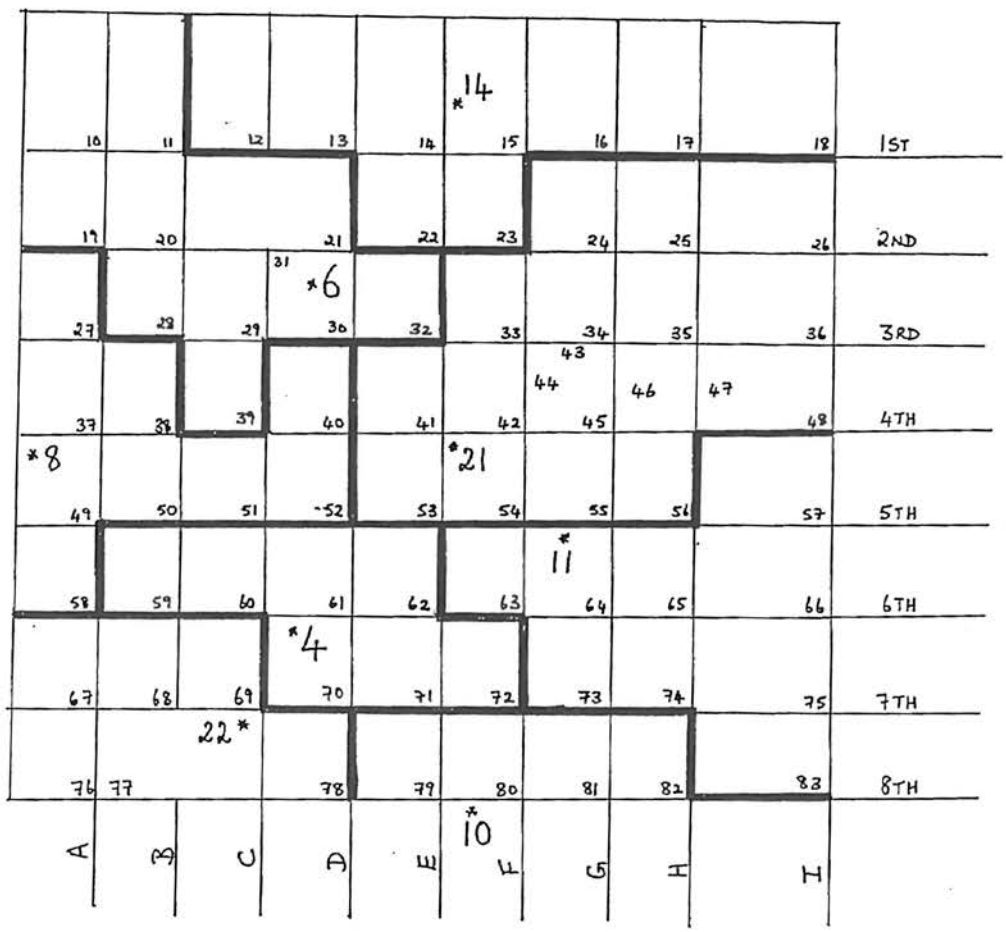
Location #	Avg. # of emergency calls/service area
14	
6	
21	
8	
11	
4	
22	
10	

10. Rank order (in descending order) the dispatch locations on the basis of non-emergency calls.

Rank	Location #	# of Calls
1		
2		
3		
4		
5		
6		
7		
8		

11. Check the service areas that have more than 100 non-emergency calls on the grid for all dispatch locations.

12. Allocate the new dispatch location in the location map provided at the end.



APPROXIMATE SERVICE AREAS FOR 8 LOCATIONS

NUMBER OF CALLS PER DISPATCH LOCATION

ALL LOCATIONS			
LOCATION		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
14	298	244	542
6	982	986	1968
21	1161	879	2040
8	1250	841	2091
11	254	343	597
4	1174	692	1866
22	341	132	473
10	149	36	185

NUMBER OF CALLS PER SERVICE AREA

GROUPED BY DISPATCH LOCATION

LOC ATION 14			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
12	41	49	90
13	96	41	137
14	26	2	28
15	10	9	19
16	18	1	19
17	3	0	3
18	5	0	5
22	93	142	235
23	6	0	6

LOCATION 6			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
10	8	9	17
11	24	32	56
19	90	44	134
20	64	87	151
21	0	0	0
28	108	75	183
29	258	450	708
30	107	64	171
31	126	68	194
32	61	33	94
39	136	124	260

LOCATION 21			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
24	7	1	8
25	2	0	2
26	0	0	0
33	34	41	75
34	5	3	8
35	0	0	0
36	0	0	0
41	196	138	334
42	159	40	199
43	0	0	0
44	6	5	11
45	5	1	6
46	0	0	0
47	3	7	10
48	0	0	0
53	480	429	909
54	234	122	356
55	24	25	49
56	6	67	73

LOCATION 8			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
27	32	13	45
37	189	194	383
38	86	68	154
40	257	313	570
49	68	22	90
50	105	24	129
51	174	89	263
52	319	112	431
58	20	6	26

NUMBER OF CALLS PER SERVICE AREA

GROUPED BY DISPATCH LOCATION

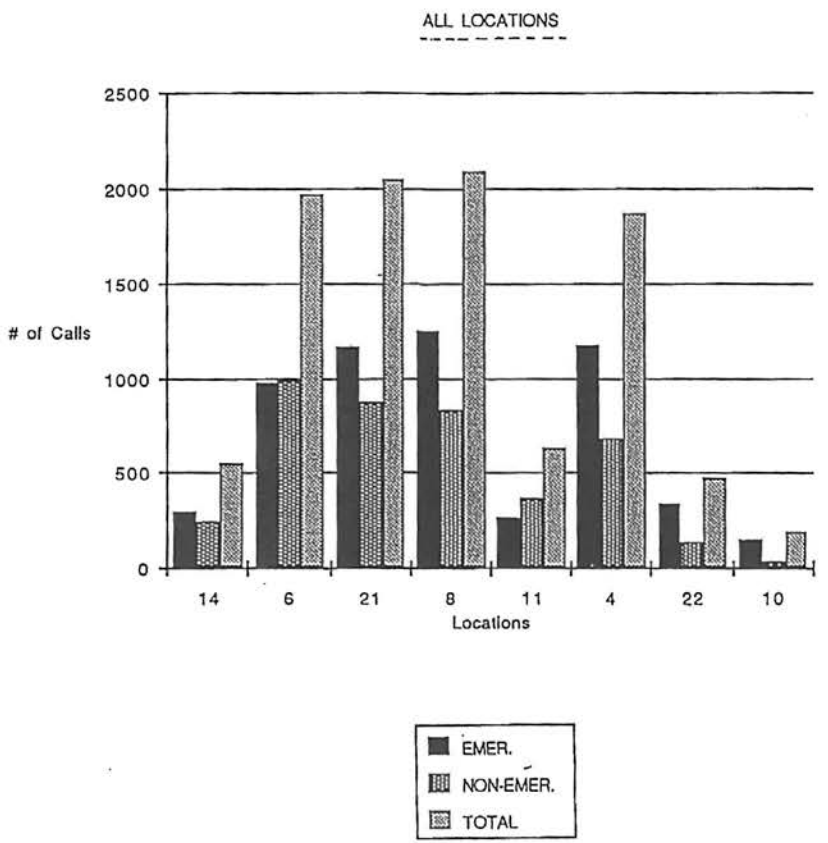
LOCATION 11			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
57	8	26	34
63	83	25	108
64	106	79	185
65	22	158	180
66	5	43	48
73	33	29	62
74	1	4	5
75	2	0	2
83	2	5	7

LOCATION 4			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
59	40	22	62
60	116	23	139
61	192	76	268
62	242	138	380
70	281	221	502
71	232	187	419
72	71	25	96

LOCATION 22			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
67	6	2	8
68	12	1	13
69	122	45	167
76	6	5	11
77	55	19	74
78	140	60	200

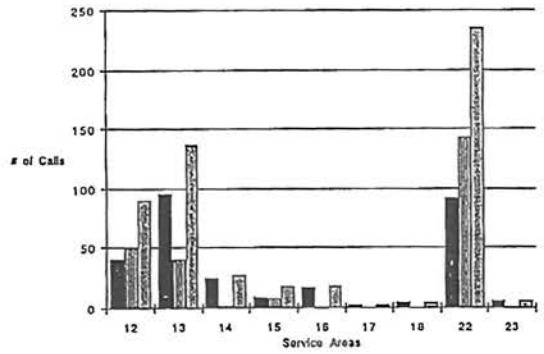
LOCATION 10			
SERVICE AREA		# OF CALLS	
	EMER.	NON-EMER.	TOTAL
79	108	30	138
80	33	6	39
81	8	0	8
82	0	0	0

NUMBER OF CALLS PER DISPATCH LOCATION

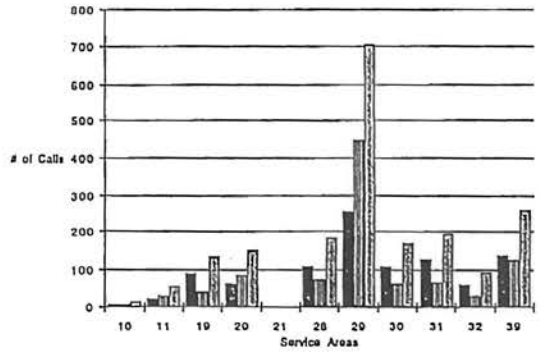


NUMBER OF CALLS PER SERVICE AREA GROUPED BY DISPATCH LOCATION

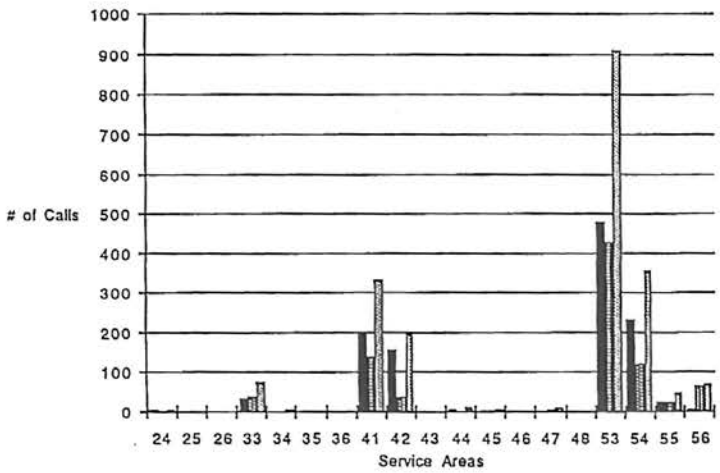
LOCATION 14



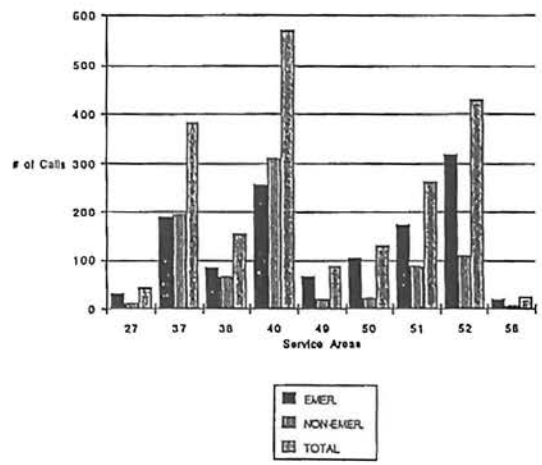
LOCATION 6



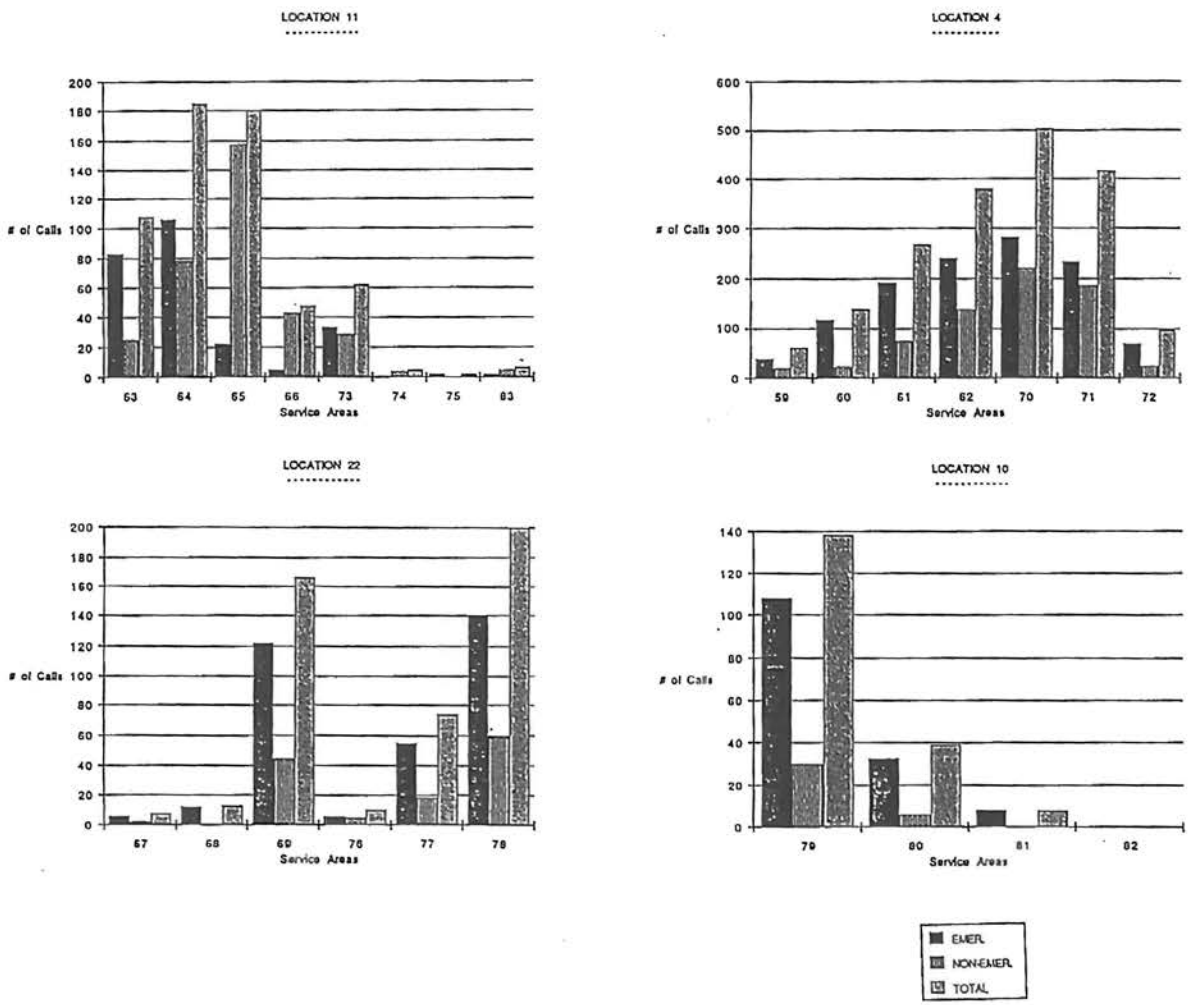
LOCATION 21

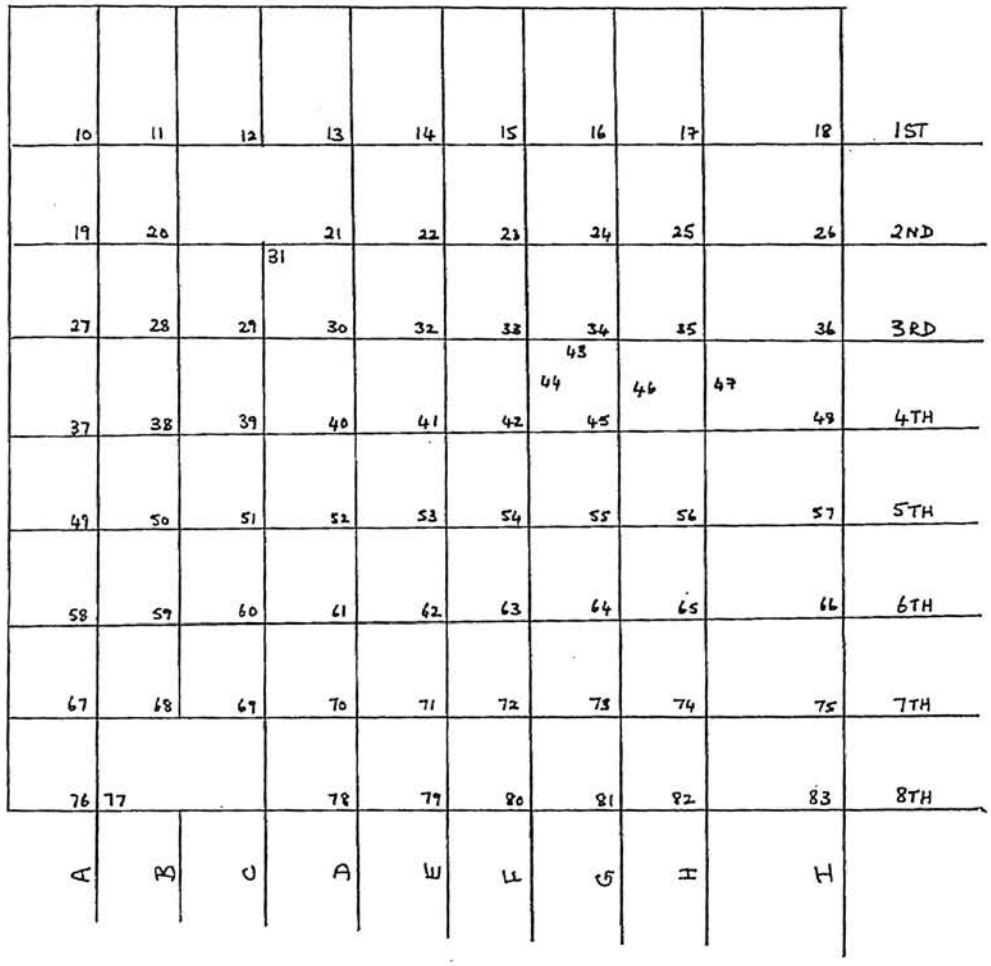


LOCATION 8



NUMBER OF CALLS PER SERVICE AREA GROUPED BY DISPATCH LOCATION




10 11 12 13 14 15 16 17 18 1ST
19 20 21 22 23 24 25 26 2ND
31
27 28 29 30 32 38 34 35 36 3RD
43
44 46 47
37 38 39 40 41 42 45 48 4TH
49 50 51 52 53 54 55 56 57 5TH
58 59 60 61 62 63 64 65 66 6TH
67 68 69 70 71 72 73 74 75 7TH
76 77 78 79 80 81 82 83 8TH
A B C A E F G H H

VITA

GEETHA R. MANICKAM

Master of Business Administration

Report : A TAXONOMY AND EXPERIMENTAL DESIGN TO STUDY THE IMPACT OF MODE OF INFORMATION PRESENTATION ON DECISION EFFECTIVENESS

Major Area: Management Information Systems

Biographical Sketch:

Personal Data:
Born in Madras, India, December 24, 1961;
the daughter of M.S.Ramachari and Vijayalakshmi Ramachari.

Education:
Graduated from Good Shepherd Convent, Madras, India, May 1978;

Received the Bachelor of Commerce degree from Ethiraj College, University of Madras, Madras, India, June 1982.

Professional Experience:
Graduate Assistant, College of Business Administration, Oklahoma State University, Sep. 1987 to May 1989;

Junior Consultant, Computer Services Division, Shaw Wallace & Co. Ltd., India, Aug. 1986 to Nov. 1986;

Junior Management Trainee, EDP Department, Best & Crompton Engineering Ltd., India, Jun. 1985 to Jul. 1986.